THE AMERICAN GAS LIGHT JOURNAL

REDMAN & KENNY, N.Y.

PUBLISHING OFFICE No. 32 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, HEATING, MECHANICAL, CHEMICAL AND GENERAL SCIENCE.

VOLUME LXXII.—No. 15. Whole No. 1,296. | NEW YORK, MONDAY, APRIL 9, 1900. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager. THOMAS J. CUNNINGHAM and ELBERT P. CALLENDER, Editors.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

Published on each Monday of the year, at No. 32 Pine Street, New York.

Collections are invariably made directly from this office for subscriptions, advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

Terms of Subscription, Including Postage.—For the United States and Canada, $3 per annum. European countries, $5 (£1—25 francs). All payments to be made in advance. Single copies, 10 cents.

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CONTENTS.

An Asterisk (*) denotes an illustrated article.

OFFICIAL NOTICE—
Wrinkle Department, Western Gas Association..... 561

EDITORIALS—
Briefly Told..... 561
Street Lighting—An Anniversary Celebration—Notes.
Applications of Electrolysis..... 562
Proceedings, Sixteenth Annual Meeting, Ohio Gas Light Association
Official Report, Revised by the Secretary—Continued from Page 530..... 562
First Day, Afternoon Session—Street Lighting, by Gen. Andrew Hickenlooper—Discussion—The Present Status of Fuel Gas, by Mr. John R. Lynn—Discussion—Prepayment Meters, by Mr. John D. McIlhenny—Discussion.
Laying a 36-Inch Water Main Under the Harlem River, N.Y..... 575
Gas Companies and Peripatetic Gas Testing, by Mr. N. H. Humphrys..... 576
ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 577
Death of Mr. John Eimer—Sale of the Vineland (N. J.) Gas Works—Contract for the Berlin Iron Bridge Company—The Spring Valley (N. Y.) Gas and Electric Company—Hints from Colorado Springs, Col.—Gas Works Proposed for Girard, Pa.—The Lynn (Mass.) Company's Liberality—The Philadelphia Suburban Gas Company—Death of Mr. W. D. Field—Gas for the Island, Toronto, Can.—Death of Mr. F. B. Whittemore—Gas Meter Inspection, Massachusetts—Cheaper Gas for Baltimore, Md.—No Carbon-Dioxide Franchise Renewal, Rockford, Ills.—Annual Meeting, Montreal, Can.—And Other Items.
The Market for Gas Securities..... 579

[OFFICIAL NOTICE.]

Wrinkle Department, Western Gas Association.

WRINKLE DEPARTMENT WESTERN GAS ASSOCIATION,
OFFICE OF THE EDITOR,
112 NORTH BROAD ST., PHILA., PA., Feb. 16, 1900.

To the Members of the Western Gas Association: The Western Gas Association elected me last year Editor of its Wrinkle Department. The duty of the Editor is the securing (for presentation in convenient form to the Association, at its annual meeting), all possible wrinkles, ideas, devices, suggestions, etc., that during the year have been found by the members to be clever and helpful, in either the construction or operation of a gas works or company.

The success of the Wrinkle Department has been marked. It is looked forward to yearly with interest. *Its success, however, is dependent on the co operation of the members.* Will you not kindly help the success of this feature at this year's meeting by sending me shortly a brief description of any thing or idea that you may have recently noticed, or that occurs to you as suitable for a "wrinkle?" Whether this be something noted by either yourself or your assistants or helpers, in your own works or in those of another, is not material. It is the point itself that is desired, and that each member is asked to kindly contribute, whenever possible.

Drawings necessary to illustrate an idea need not be exact or carefully made, a simple rough sketch will be sufficient, and will be redrawn here if desirable. Your active co-operation in the above will be appreciated by the Association at large, and by the Wrinkle Editor in particular.

Very truly yours, F. H. SHELTON, Editor.

BRIEFLY TOLD.

APR 9 1900

STREET LIGHTING.—The papers read this year before the various gas associations whose meeting times have passed were of a high order, which holding must be admitted by those who even hurriedly studied them. The New England Association led off in good shape, in February last, with four numbers, at least two of which have come in since for much comment, the two being these: "Pumping Gas Five Miles at 20 pounds Pressure," by Mr. F. H. Shelton; and "Some Notes on Oil and Tar Burning," by Mr. B. J. Allen. The former has not received complete assent as to its teachings from those who comprehend the radical departure that it advocates; but the very boldness of its suggestions has not been without fruit, in that Mr. Shelton has started his readers, as he had started his hearers, to thinking. Mr. Allen's paper was the other New England number that attracted wide attention; but in his case his audience had no other remark to make than that all must agree with him in his historical and descriptive recital. Then came the meeting of the Michigan Association, with its list of four set papers; and of these it may not be gainsaid that the one by Mr. Sedgwick Dean, on "Differential versus Uniform Prices for Gas," has been discussed the most. Nor has the discussion been altogether in favor of the views favored by Mr. Dean. In fact, the reverse seems the case. Now we are confronted with the papers that were put before the Ohio Association last month. Six in number, they were all on topics up to the times—for that matter, every paper so far read this year before our associations may be so classed—and it will we think be agreed upon, when all of them have gone through the mill of mental digestion, that the Governor-General gas man of Ohio, Andrew Hickenlooper, can be credited with having prepared the one that will attract the most attention. Quite at home with his subject—"Street Lighting"—for he has

been concerned therein for years and years, his remarks thereon have the weight of authority, the stamp of frankness and the seal of truth. Apart from the value of the paper from a historical point of view, which is great, the General lays down some cold facts (which facts are also very plain) respecting street lighting according to the most modern methods, and his opinions thereupon are those of a master, for he, to use his own words, is connected with a Company (the Cincinnati Gas Light and Coke Company and its branches) that "is to-day supplying fully two thirds of the private electric lighting, both arc and incandescent, in the city of Cincinnati." The hard sense of the General plainly shows in his practical conclusions, and interpret the latter as liberally as one may, the result will not down that street lighting by means of incandescent gas lamps is bound to grow in popular favor even in greater speed and force in the future than in the past, great and swift as that growth has been. Efficiency and economy are always determining factors, and these are possessed to an exceeding degree in the domain of street lighting by the improved or modern Welsbach lamp.

An Anniversary Celebration.—"On the first inst. Mr. Charles A. Gerdenier completed his 36th consecutive year as Superintendent of the Bridgeport (Conn.) Gas Company. He entered the service of the Company in 1864, prior to which time he had been in the employment of the Nyack (N. Y.) Gas Company. The anniversary this year was suitably remembered and marked by the absorption of an excellent dinner tendered by Mr. Gerdenier to the "Gas House Micks' Association," otherwise the association of the employees of the Bridgeport Gas Company, of which body Mr. Gerdenier is an honored member. The affair was thoroughly enjoyed by the happy party who shared in its food and frivolity.—Observer."

Notes.—The proprietors of the Wichita (Kas.) Gas, Electric Light and Power Company have authorized Superintendent Baker to expend a large amount in main extensions. It is also understood that the purifying apparatus will be renewed or reconstructed on a greatly enlarged scale.——According to the report of the Director of Public Works of Philadelphia, the United Gas Improvement Company laid 77 miles of gas mains in that city during the last year.——A correspondent, writing from Richmond, Va., under date of April 2d, says: "A charter was granted last week to the Manchester Light, Heat and Power Company, of Manchester, Va., by Judge Ingram, of the Hustings Court. The object of the Company is to supply, distribute, manufacture and sell gas and electricity for public and domestic and mechanical uses and purposes in the city of Manchester and in other places in the State of Virginia. The capital stock is to be not less than $5,000 nor more than $50,000, divided into shares of $100 each. The principal office of the Company is to be in Manchester, Va., and the names of the officers are as follows: Directors, A. L Adamson, George E. Garey, A. J. Daffron, William P. Matthews, Augustine Royall, E. H. Wells and Clarence Vaden; President, A. L. Adamson; Treasurer, George E. Garey; Secretary, A. J. Daffron."

Applications of Electrolysis.

The *Electrical World* notes that, in a recent paper read before the Chicago Electrical Association, Mr. C. F. Burgess illustrated in an interesting manner the scope of electrolytic action by reference to an old file. Imagine, he said, that we have an old rusty file, which has been pretty well worn, with the tang broken off, covered with oil and grease, and upon which paint or varnish has been spilled. We may first suppose it to be suspended as the cathode in a solution of common salt, and current under a pressure of about six volts caused to pass. A rapid formation and evolution of gas bubbles will be produced upon the surface of the iron, and these will exert the physical effect of working under the paint and varnish and thus quickly freeing the surface of these materials. The sodium, which is liberated by the current, unites with the water to form a caustic alkali solution at the iron surface, and this has the action of saponifying the oil or grease, just as would be done were the greasy article boiled in a lye solution. Again, the reducing action of the sodium and hydrogen will cause the brown rust to entirely disappear. We may now reverse the direction of the current, and the file which has been cleaned of paint, oil and rust will become evenly and uniformly corroded or dissolved, with the result that the teeth become more pointed and producing a sharpened file.

To shape a new tang to fit into the wooden handle, the end of the file may be dipped as the cathode in the solution, and by increasing the pressure very materially cause the iron to heat up, lose its temper and finally attain a temperature sufficiently high to be worked upon an anvil. Suppose now, that the file be used upon brass or copper or lead, which will soon clog it up and render it useless. The freeing of the teeth may be quickly and conveniently done by placing it as the anode in a solution which will dissolve the foreign metal without touching the steel of the file.

[Continued from page 530.]

PROCEEDINGS, SIXTEENTH ANNUAL MEETING, OHIO GAS LIGHT ASSOCIATION.

Held in Convention Hall, Chittenden Hotel, Columbus, Ohio, March 21 and 22, 1900.

First Day, March 21—Afternoon Session.

The Association reconvened at 1:30 P.M. Having called the meeting to order the President introduced General Andrew Hickenlooper, President of the Cincinnati Gas Light and Coke Company, who prefaced the paper that he was about to read in the following remarks: Gentlemen—Your very able, efficient and persistent Secretary must be held responsible for my appearance before you to-day. He even took the trouble to make a personal visit to Cincinnati to enlist me in the cause, would accept no assertions of pre-occupation as an excuse, and suggested that I read a paper to this Association entitled "What I Know about Gas Raiders;" but, realizing I had surfeited the public with that character of literature, I positively declined. Nothing daunted, he came back again and insisted that if I wanted to preserve my name as an Honorary Member of this Association I would have to contribute something towards the entertainment of the gentlemen present. So I am here to-day, very much under the conditions of the young man whose admiring friends, shortly after he was married, presented him with a cuckoo clock. The clock was brought home and duly installed in the upper hall. A short time afterwards he had occasion to remain at his club until 3 o'clock in the morning. He got home and pulled off his boots in the lower hall, but unfortunately dropped one. The noise brought his wife to the top of the stairs. She exclaimed, "Charles, is that you?" He replied, "Yes, my dear." She asked, "What time is it, Charles?" He said, "It is about 12 o'clock;" and just then that cuckoo clock let go and I had to stand there like a blamed fool and cuckoo the other nine. (Long continued laughter and applause.) So I am here to-day, gentlemen, simply to "Cuckoo the other nine" of the space allotted to the reading of papers. (Renewed laughter and applause.)

The General then read the following paper on the subject of

STREET LIGHTING.

Gentlemen: Day has ever been regarded as the natural season of business activity, and night the period of rest; but the constantly changing conditions of the world's business and social relations have caused the former to encroach upon the latter, and we are thus forced into making proper provision for meeting such existing conditions by a more general and effective illumination of public thoroughfares, which may properly be defined as that character of lighting which in our advanced stage of civilization has become absolutely necessary for public convenience and police protection, under the two essential conditions of efficiency and economy.

Passing rapidly over the non essential features of the gradual development of such agencies from the bonfire to the bunch of blazing fagots; from the pitched torch to the dried rush; from the primitive oil lamp to the improvements of Argand; from the tallow dip to the wax candle or "King's timepiece"—used not only for purposes of illumination, but to mark the passing hours of 1484, around which still linger recollections of association with innumerable legends, religious ceremonies and the "candle hymn," in which the family joined at close of day, on up to 1662, when public convenience recognized the necessity of establishing in the principal cities booths or stations where such lights could be rented for temporary use; a measure subsequently improved upon by the organization of corps of "torch bearers" or "link boys," whose services could be hired by the belated traveler—maintained until it slowly dawned upon the minds of the people of that period that some still better and more acceptable system was worthy their consideration, we return again to the subject of lighting as applied to social requirements and public necessities, rather than personal accommodation and use.

From the best recorded evidence, the Governor of Eddesa was the first to recognize the importance of street lighting, through the promulgation, A.D. 505, of an official order requiring lamps to be placed and kept burning during the night along the principal public thoroughfares of that city, to aid in which he confiscated the oil which had previously been donated to the churches and monasteries. But it was not until the beginning of the 16th century that the most populous cities of the old world recognized the importance of public street lighting, either at the expense of the municipality or by officially directing citizens to contribute toward the object by placing lights in their front windows.

The first effort in the line of a purely municipal undertaking appears to have been by the authorities of Paris, in 1558, when they erected, at public expense in some of its principal thoroughfares, large metal receptacles or vases, charged with pitch, rosin, etc., kept burning during the night. For these beacon lights oil lamps and lanterns were substituted in 1776, but it was not until ten years later that the important thoroughfare between Paris and Versailles was thus lighted at the suggestion of the Chief of Police as a measure of public safety, and the undertaking was regarded of such importance that a medal was struck to commemorate the event.

While the Mayor of London, as early as 1417, directed citizens to hang out lanterns in front of their residences during the winter months, and succeeding mayors for 100 years endeavored to enforce the order, it was not generally obeyed, and this led to a recognition of the fact that some more effective system would have to be adopted; so in 1635 Edward Heming obtained a concession from the municipal authorities to light the streets of London by placing a lantern before every tenth door, to be lighted from dark until midnight during the winter months, and for which he was accorded the privilege of assessing the expense upon the citizens residing upon the streets thus lighted. This scheme had the support of those not assessed, and the opposition of those compelled to pay, and in consequence this plan of municipal progress ultimately failed.

Finally, in 1716, the municipal authorities of London took official action by promulgating orders, requiring householders whose premises fronted on any street, lane, or public passage, to hang out lamps or lanterns in front of their premises from 6 to 11 P. M. every dark night, under penalty of arrest and imprisonment for neglect, but as late as 1725 this order was very imperfectly obeyed, with the resultant effect that life and property had little protection during the hours of darkness. In the meantime, from 1669 to 1783, the cities of Amsterdam, Copenhagen, Hamburg, Berlin, Vienna, Leipsic, Dresden, Hanover and Birmingham recognized the necessity for street lighting in various incomplete and imperfect ways.

The attempted enforcement of a public duty upon the private citizen, even under the strongest penalties provided, did not prove either satisfactory or effective, and soon gave way to the first municipal contract, which provided, that in consideration of the annual payment of £600, a concession, or franchise privilege, should be granted for the placing of lamps along the public thoroughfares, and lighting the same—presumably on a moonlight schedule—for 117 nights per year; for which the contractor was accorded the privilege of collecting a lighting tax of 6s. per annum from each householder whose premises exceeded a rental of £10 per annum, and who failed to maintain a private light in front of his premises.

This partial lighting proved unsatisfactory then, as it does in this more enlightened age, and it was followed, in 1736, by an appeal to Parliament for municipal authority to undertake the work. This being granted, glass lanterns were first introduced, and were kept lighted every night and all night throughout the year. It was then supposed perfection had been attained, and all civilization rested content with the progress made until the celebrated chemist, Von Helmont, of Brussels, discovered the existence, in solid bodies and fatty matters, of "an invisible and impalpable substance," to which he gave a name of his own coinage, "gas," more forcibly brought to public attention by Thomas Shirley, who, as early as 1658, communicated to the Royal Society his observations and experiments with gas issuing from a well at Wigan; and was followed some 30 years later by John Clayton calling attention to the practicability of generating gas through the destructive distillation of coal.

Another half century followed before his experiments were reinforced by those of Dr. Hales, in 1726; Priestley, in 1774; Bishop Watterson, in 1750, and Lord Dundonald, in 1787, experiments that probably inspired Murdoch to his more practical and effective work in 1792, followed by those of M. Lebon, at Paris, in 1801, which may be regarded as the beginning of the practical utilization of the stored sunshine of former ages, freed from its confinement, unfortunately at a time when little could be done toward the full development of this new agency of illumination, owing to the fact that science was so slightly advanced, skilled investigators were so few, and absolute secrecy marked every step of progress, which long delayed the full development of this newborn agency of illumination.

Thus, remarkable as it may appear, it was over half a century from the first clearly proven demonstration of the inflammable character of gas that it occurred to any one to apply this knowledge to any practical use. And even then such a thought was not the result of scientific research, but was due to the practical common sense of a mining engineer of Cornwall, who, in 1792, demonstrated the practical utility of gas by lighting his own house with it, and who six years later constructed the first apparatus for its generation.

While Murdoch may be justly entitled to unstinted praise for his labors from 1798 to 1801, and be fairly credited with being the first to enlist public confidence in the practicability of gas lighting, due credit has never been accorded Winsor for being the first to comprehend the future possibilities and magnitude of this industry, which he promoted with indomitable energy, perseverance, and self sacrificing devotion to the single purpose of compelling the English Parliament to recognize the merits of his proposed undertaking.

He was an enthusiastic "promoter" of the most pronounced type, who, in endeavoring to secure authority for the establishment of the "National Light and Heat Company" met with the determined opposition of the "Guild of Chandlers," the "whale fisheries," and even the butchers, who claimed that if gas superseded candles the value of tallow would be reduced, and in consequence the charge for lean meat must be increased to compensate for the loss. These, with other allied interests, which it was claimed would be injuriously affected, perfected a formidable organization, which enlisted not only the sympathy of the masses but the aid of several of the most eminent scientists of that period in opposition to the proposed measure. Sir Humphrey Davy, in opposition to the claims of originality and priority, asserted that the ability to extract gas from coal had been known for over half a century, and ridiculed its asserted prospective commercial value Lord Brougham declared the idea preposterous, and only worthy the philosopher who proposed to extract sunbeams from cucumbers. Napoleon pronounced such an undertaking the height of folly; while the Chairman of the Committee said to Winsor, "My friend, when you assert that it is possible to have a light without a wick you are trying to prove too much." 41 witnesses were examined by the committee, and their united testimony condemned the use of gas as impracticable and dangerous; while the general public were led to believe that explosions, fires, and even new forms of diseases would follow the introduction upon their premises of the subtle and poisonous compound.

Upon the other hand, the most extravagant and ridiculous prophesies were made as to the commercial value of its introduction and practical utilization. The first prospectus of the proposed company asserted that the profits would be so enormous that £500 would be returned for every guinea invested; which false and misleading representations subsequently led to undertakings ending in financial disasters in which thousands were ruined.

Finally, after several years of contention, Parliament, in 1812, granted a charter to the London and Westminster Gas Light and Coke Company, subsequently called the "Chartered Company," of which Mr. Clegg became engineer. Though Pall Mall had been experimentally lighted in January, 1807, it was not until 1813 and 1814 that any considerable number of the streets of London were lighted with gas. And thus civilization, which for centuries had prided itself upon its lanterns and lamps, opened its doors to progress by a very general recognition of its utility and commercial value, under the inspiration of which numerous companies were established in London, until 13 separate organizations were indiscriminately contending for patronage, bringing about such deplorable conditions that an enforced consolidation and re districting became necessary, and was finally carried into effect in 1855.

Paris followed London's lead by granting concessions to several operating companies, between the years 1818 and 1822; but the municipality itself was slow to adopt the new system to the illumination of its public thoroughfares, for as late as 1829 but 40 gas lamps had been erected, while 3,000 oil lamps, which had been installed three-fourths of a century before, were still in use as late as 1844.

The first official action in regard to the illumination of public thoroughfares in America was taken by the City of New York, through the promulgation, in 1697, of an order requiring every seventh householder, along the streets to be lighted, to either place lamps in their front windows, or suspend a lantern from a pole erected in front of their houses; and in this way the streets of that city were lighted until 1761, when the municipality assumed the control and expense of maintaining the necessary lights of the character named, until 1816, when official action was first inaugurated looking to the introduction of gas as a street illuminant.

While Mr. Hendry, of Northumberland, as early as 1801, publicly advocated the practicability of the new light in this country, and David Melville, of Newport, R. I., in 1806, demonstrated its utility by lighting his own residence, it was not until May 12th, 1823, that the

municipality made a contract with the New York Gas Company to light with gas the streets of that city south of Grand street.

While it has been generally conceded that health, morality, energy, intelligence, and the charms of social intercourse are all enchanced by an abundance of light, as surely as its absence indicates and encourages the presence of immorality, ignorance, degeneracy, and crime, yet it can hardly be claimed that our ancestors were very enthusiastic in their welcome of the new light, as the efforts of its promoters were met at every turn with the most determined opposition of those who favored the continued use of oil lamps, not only for private lighting but for public service, with the resultant effect that it was not introduced in Baltimore until 1821, Boston 1822, New York in 1823, and not in Philadelphia until 10 years later, and this notwithstanding the fact that this city was the first one in America to witness a practical application of gas lighting to interior illumination of public buildings—the New Theater—November 14, 1816.

Among the first steps looking to the introduction of gas lighting in the West was that taken by John Towne, of Pittsburg, Pa., who, under date of September 5, 1827, transmitted to the municipal authorities of Cincinnati a communication in which he proposed to undertake the lighting of that city's public thoroughfares with gas at an expense of 15 per cent. less than under the prevalent system of lighting with oil lamps. After considerable discussion the proposition was accepted, conditioned, however, that he would "Guarantee that lighting with gas will not injure the health or endanger the property of the citizens to a greater degree than the use of oil." To this conditional acceptance Mr. Towne made no reply, presumably from an indisposition to assume such a great responsibility.

Four years later an effort was made to enlist local capital in the establishment of a plant, followed by several other spasmodic efforts in the same line, none of which were successful. Finally, at the solicitation of several prominent citizens, the Ohio Legislature, on April 3d, 1837, granted a charter for the organization of the Cincinnati Gas Light and Coke Company, but the same parties were unable to secure sufficient stock subscriptions toward the proposed capital of $150,000, and the undertaking lay dormant until early in 1841, when a young Englishman named James F. Conover undertook the task, under ordinance provisions granted June 16, 1841.

Under his determined leadership and persistent energy the works were built from which gas was first sent out on January 14, 1843, and just one year later was first supplied to public lamps, 16 in number, at a charge equivalent to two-thirds the average price charged private consumers in the cities of New York, Baltimore, New Orleans, Louisville and Pittsburg.

This action was followed in Ohio by the organization—between the years 1844 and 1850—of the following Companies : Cleveland, Columbus, Dayton, Springfield and Zanesville. From 1850 to 1860, 15 additional companies were organized ; and during the next succeeding 10 years about the same number, showing that fully one-half the gas companies of this State can claim to have "rendered the State some service" for over a third of a century.

The volume of light necessary for the proper illumination of public thoroughfares must depend to a greater or less extent upon the general character of the territory to be lighted and the purpose such lighting is intended to subserve. One general system of illumination may be best suited to country villages and another to metropolitan cities ; one to suburban territory and another to residence districts ; one to business centers and still another to congested districts. The system may be varied in each, from beacon lights to the most brilliant artificial illumination ever installed, which Fontaine has figured out cannot be made to exceed 1-10,000th of the light of day. But whatever system, agency or character of lighting may be adopted it should be such as to afford absolute uniformity of light over the entire surface of the street to be lighted. In other words, the comparative serviceability of any system adopted must be based, not upon the intensity of the initial power, but upon its divisibility of source and uniformity of illumination.

Richards claims that "The more powerful the source, the higher must be the scale of lighting over the whole area to be lighted," a conclusion reinforced by Webber's rule : "The practical measure of the efficiency of a light is given by the difference between the brightest and the darkest part of the illuminated area." While Wybauw and other scientists assert that any excess of lighting at the point of ignition should not be recognized because it is practically wasted ; that the true measure of effective street lighting should be based, not upon the lightest but upon the darkest part of the area lighted.

Lavoisier goes still further and argues that in street lighting such excess is not only wasted but that it throws into obscurity objects easily distinguishable in its absence ; and that it is, therefore, advisable to diminish such excess, even at the expense of wasting a portion of that available.

Even our distinguished, but conservative associate, Mr. Humphreys, has said : "In all this we are reminded that a weaker light source more effectively distributed, with a view to uniformity in lighting over the plane to be illuminated, may give a final result much superior to that obtained from a stronger light source improperly applied. Our efforts should, therefore, be to modify the law of distances, so that as far as practicable the illumination may be distributed uniformly where required."

It, therefore, appears ridiculously absurd to advocate the use of lights of great intensity where conditions of comparative economy preclude their being used with such lavish prodigality as to make such brilliancy uniform ; for all observation and experience have forced upon even the most unintelligent the conclusion that whatever system of lighting gives the greatest uniformity of illumination over the whole surface to be lighted that must be adjudged the most serviceable.

The adoption of any system of lighting, founded upon such principles, becomes an important factor in progressive civilization ; not only by exerting a beneficial influence upon the social and business interests of the community thus served, but by affording through its moral police powers increased security to life and property. It is a mistake to assume that the duty of a municipality is fulfilled by brilliantly illuminating a few of its most prominent thoroughfares at the expense of less favored localities. Primeval savagery has not disappeared from our most populous cities ; it is only held in check by the co-operating forces of law and light, each contributing a forceful influence toward the suppression of crime, lawlessness and immorality, that lurk unseen in the hidden habitations of the deprived, ready to take advantage of the unintelligent parsimony of official supervision.

Illuminating power and illuminating effect, although frequently confounded, are by no means synonymous terms, however much they may be considered identical by the unenlightened public. While scientific discussion has eliminated all doubt as to the non-existence of such differences, no comprehensive or satisfactory explanation as to the causes of such differences has been given.

No less distinguished an authority than Thomas Newbigging says :

"The truth of this is vividly impressed upon us by observations of the illumination afforded by the arc electric lamp, where there is an intense central point, with a by no means proportionately great difference in diffusive power, or illuminating effect.

"I do not mean to say that I can scientifically explain the cause, but it nevertheless exists, and I hope some one will soon be able to satisfactorily explain the phenomenon."

In which publicly expressed views the equally, and possibly more eminent scientist, Wm. Sugg, has fully concurred. So, too, has George Livesey, whose name is familiar wherever artificial illumination is known. And Mr. Humphreys adds :

"There is undoubtedly a difference between the intensity of the luminous source and the intensity of the illumination. One refers to the cause, and the other to the effect."

I admit that, from a purely scientific standpoint, photometry may be relied upon as a means of ascertaining the comparative power of lights which approximate in character, and are tested under similar circumstances and conditions, one of the most important of which is the effect upon the eyes of the observer engaged in making such a test ; and it now remains for scientific research to show how far such conditions have entered into calculations of results heretofore reported. We have all been taught to regard with absolute confidence the results of photometrical observations, but may we not have overlooked important contributory conditions of visual powers influencing observation, a condition not to be ignored if we are to attain exactness in deciding upon comparative illuminating effects.

Photometrists, from Accum down to the present time, have treated the subject of illuminating power without reference to illuminating effect, never apparently realizing that the former is a purely scientific term that ought to be used with discriminating care, if we are to avoid confusion in the distinction between cause and effect. In fact the latter, in so far as street illumination is concerned, cannot be exactly measured by any photometer yet invented. Rather is it to be determined by local topographical conditions, the needs and requirements of the community to be served, coupled with the powers of human vision, which latter can only be measured by impressions left upon the retina, which may be agreeable and satisfactory in one case, and exceedingly annoying—possibly paralyzing—in another.

The eye is only capable of determining comparative lighting values

when in its normal condition, which is certainly not the case when called upon to quickly adjust itself to sudden changes of intensity, involving a dilation or contraction of the pupil or iris, covering a range of from 1 to 16; and hence, under such conditions, may we not be justified in refusing to submit entirely to photometrical guidance, especially so when considering only the effect of various lighting agencies, utilized in a practical way for street lighting purposes, under conditions radically different from those governing interior illumination?

If called upon to define the difference between "illuminating power" and "illuminating effect," I should say that the first may be an intensely concentrated light, the rays of which diverge from a single point and decrease in intensity inversely as the square of the distance; while the rays of the second, emanating from several points, send out diverging, converging and parallel rays, thus mingling in unknown proportions rays subject to decreasing, increasing, and constant, effect; possibly of less direct photometric intensity, but of greater combined illuminating effect—greatly enhanced by normally conditioned eyes which have not been paralyzed by direct rays from a light source of great intensity, or abrupt variations in the degree of luminosity. Conditions similar to those which may be produced by looking at the sun on a bright day, after which the retina is rendered temporarily incapable of appreciating the value of the given impression, until it has recovered from the excessive excitation produced, and the pupil has had time to expand and resume its normal functions.

These conditions being admitted, we are brought face to face with the fact that it is one thing to produce an intensely concentrated light, but quite another to utilize such a light in a manner proportionate to its intensity. The very brilliancy of its source may prove a detriment rather than an advantage, to be remedied only by finding some means for reducing its initial power or enlarging its radiating surface. To express the value of such a light by comparing its photometrical candle power with one of less intensity but greater diffusibility, ignores the fundamental distinction between light and lighting.

Kerosene oil, electricity and gas are now the three systems of lighting competing for public favor. While oil fed lamps have ever been and still are important factors in the street lighting problem, and especially so since the introduction and use of the refined products of petroleum in self gas generating lamps, it is impossible to trace the history of gradual development from the type that slept for 2,000 years beneath the ashes of Vesuvius, on up through subsequent improvements, so numerous and effective, that it has through all these years maintained a place in the front rank of acceptable agencies of street illumination; a position now made more secure by the success which has attended its utilization of the Welsbach mantle, especially in localities where gas is not available. The incandescent electric lamp, erroneously credited to the inventive genius of Thomas A. Edison, was first brought to public attention by Sir Edward King, of London, as early as November 4th, 1845, when he patented his system of electrical illumination by means of an incandescent filament in vacuo, the specifications of which patent, No. 10,919, are almost identical with the more recent claims of Mr. Edison, who, confining his experiments to a decrease in the cost of production, addressed himself to the only substantial problem relating to the subject which was unsolved before he began.

The experiments of King were followed by those of Prof. Starr, in 1846, though the principles involved were not fully described nor generally discussed until M. Jobart submitted his descriptive paper, at a meeting of the French Academy held March 1, 1858; while it was not until 1879 that rumors of Edison's discoveries, supplemented by those of Swan—the details of which were not made public until a year later—caused a panic in gas shares. The subsequent development or improvement of this character of electrical service is full of interest, but not being adapted to street illumination it cannot be considered germane to the subject now under consideration.

Equally fallacious is the supposition that the arc electric lamp is a "new born" or comparatively recent discovery. It is in fact but a simple evolution of scientific investigation and development, extending over a period of nearly 100 years, or from the time when Sir Humphry Davy, in 1802, produced an electric light by passing a current from a battery of 2,000 cells over charcoal points; but it was not until 20 years later that its utility for general lighting purposes received consideration.

His investigations were followed by those of Faraday, who, in 1831, succeeded in producing an electrical current by rotation of magnets. The subsequent investigations and discoveries by Gramme, Siemens and others, while covering a wide field, were in so far as arc lighting is concerned simply built upon Faraday's foundations.

In fact, as far back as 1844, two citizens of Cincinnati claimed to have perfected such a lamp, which they exhibited in London, and for which they received an English patent in 1845, confirmatory evidence of which may be found in the following letter, a copy of which has been preserved in the files of the Gas Company.

CINCINNATI, February 5, 1843.

Jas. Norton, Secretary Baltimore Gas Co.:

Dear Sir: Your communication of 11th inst., requesting information as to the electric light, was received this morning. I regret to say that we are unable to give you any satisfaction on this startling topic. The inventors have carefully concealed their project, fearing difficulty in securing a patent. It is certain they consider their plans perfect, and in view of their success here have gone to Europe to secure privileges there. We are as truly ignorant of this unfortunate discovery as yourselves, and trust that a few months will develop the scheme as one not incompatible with the best interests of gas lighting.

Yours truly, H. J. MILLER, Sec'y Gas Co.

These early investigations were reinforced by those of Jules Duboscqu at the Paris Exhibition in 1855. Prof. Tyndall's, in London, 1856 and the illumination of Westminster bridge, by Watson in 1858. A lull followed, until October, 1876, when Prof. Jablochkoff announced the results of his experiments to the French Academy of Science. But it was not until 3 years later that he introduced his lamp to public notice, first experimentally tried in Paris, and subsequently practically operated upon some of the principal thoroughfares of London.

These demonstrations were followed by those of Brush, who, in March, 1880, installed a small 4-light plant at Wabash, Indiana; which little city may properly be credited with being the first municipality in America to demonstrate the utility of the new light by the purchase of a plant for $18,000 which was subsequently sold for $3,000.

Equally erroneous are the impressions as to the recent discovery of the principles involved in the incandescent gas light.

Thomas Drummond, a pupil of Faraday, and young engineer in the employment of the British Government, nearly a century ago conducted experiments with a view to developing the practicability of this character of light. His attention was first called to the subject by observing the intense luminosity of lime, which led to the development of the "Drummond Lime Light." No further advances were made in this direction until 1867, when Tessie du Motay took up the study of its development, and was followed by Linnemann, Koch, Cruckshanks and others, the latter with lime coated platinum; Gillard submitted his basket-shaped network of platinum; Brin brought his carbon pencils to incandescence; Khotinsky followed with his experiments upon refractory earths, such as the oxides of calcium, magnesia, zirconium, etc., all of which amounted to little, mainly through the failure to produce a heat of the required intensity. Then followed a nearer approach to the present burner by Clamond's invention of a peculiarly woven burner of platinum wire, and Fahnehjelm's magnesium pencils, bringing us up to 1880, when Dr. Carl Auer began his experiments under the tutelage of Bunsen, resulting in the production of a burner which it was supposed would fulfill all the requirements of an illuminating agency of this character, but which, in actual practice, failed to meet public expectations, especially in candle power and mantle endurance. Continued exhaustive investigations and experiments, however, not only upon his part but upon the part of many other eminent scientists, resulted in the production of the perfect burner which now appears destined to revolutionize the existing lighting systems.

While the use of kerosene and kindred oils cannot be excluded from consideration in any general lighting problem, they are not regarded as acceptable for street lighting purposes where gas or electricity can be supplied. The incandescent electric light, because of its inherent defects, limited lighting power, and excessive cost, is totally unsuited to such purposes, while gas still stands the unchallenged leader of all illuminating agencies. Science and inventive genius combined have brought about a revolution in the form of its most perfect utilization for street lighting purposes.

Arc Electric and Incandescent Gas Lamps.—As the Company with which I am connected is to-day supplying fully two-thirds of the private electric lighting, both arc and incandescent, in the city of Cincinnati, we feel qualified to dispassionately and fairly consider the relative merits of these two systems under conditions now existing, which are radically different from those of a few years ago, when the citizen as well as the scientist was less prepared and qualified to dispute the extravagant claims made than they now are.

The public announcement of Prof. Jablochkoff's accomplishments in

1876, followed by Brush's demonstrations 2 years later, coupled with the most extravagant and sensational statements of the demonstrated power and future possibilities of the new light, startled the civilized world and opened up a new field of operations to the speculative promotor, whose most extravagant assertions as to commercial value were accepted by the general public without questioning.

Lured by the promises of immense wealth and limitless fame, in an age of science and invention which finds no parallel in the world's history, thousands of ingenious minds and busy hands became active in the solution of the still unsolved problems of future development. Appliance companies, controlling patented apparatus, became active promotors of local corporations in which capitalists were anxious to invest upon any terms demanded, and thus the rapid installation of plants became purely speculative rather than legitimate business undertakings. This precipitated a panic in gas stocks, during which market values rapidly declined to not exceeding two-thirds their previous ratings. From this fall they did not rally until excessive royalties, expensive experiments and active competition brought about conditions in which promises of excessive profits became but a dream of the enthusiast. Such experiences developed the sober "second thoughts," and forced upon receptive minds a realization that no greater fallacy ever found lodgment in human brain than that a powerful and intensely concentrated light could be made economically effective for the lighting of public thoroughfares.

It is true that when lights of this character, ranging from 100 to 300-candle power, were first introduced, they produced a startling effect in localities which had never before known other than gasoline burners, or widely scattered gas lamps, with flat-flame burners limited to 4 feet consumption. Their adoption was assumed to be the need of the hour and the sign of progress; and cities and pretentious villages entered upon a swift race for precedence in adoption. The useful and economical gasoline lamps were discarded, while gas was relegated to the rear, in the firm conviction that its days of usefulness had passed, and it was to be regarded as a turned down page in the history of public illumination.

But it was early discovered that the intense concentration of light at any given point, necessarily leaving the intermediate spaces in darkness, did not fill the full measure of a satisfactory street light; because its effective rays being confined to an arc of about 30°, above or below a horizontal plane, cast a deep shadow immediately beneath, enclosed in a zone of intense brilliancy, which rapidly diminished in illuminating power, until 300 feet away it was merged into impenetrable darkness, all the more profound from the loss of sensitiveness of the eye subjected to the strong light, which causes the pupil to contract, thus curtailing the vision, so that it receives a less volume of light in the neighborhood of the lamp than it would from a light of more moderate intensity, with eyes better conditioned to admit its rays.

No one can deny that a light of 200 candle power is more brilliant than one of 20 by photometrical test; but it by no means follows from this that the former is more suitable as a unit of light for certain purposes; especially so if the perceptive power of the eyes is exposed to alternating intensity of light and darkness. Add to this the inherent objections in practical operation, such as variation in volume of current supplied, which is, at times properly focused, but only for a moment, when it again resumes its erratic course, over carbons of different shapes and varying density; covering only a portion of the circle, then shifting around with an uncertain delivery of rays, at one moment of dazzling brilliancy, and the next of comparative darkness, frequently followed by complete extinction, involving liability to damages and annoyances, which cannot be compensated for by any monetary consideration possible to name.

Under the influence of the oily-tongued "promoters," 2,000-candle power became a familiar term.

Though meaningless, deceptive and grossly exaggerated, it was like any other frequently, persistently, and impressively told lie, finally accepted by the general public, regardless of the fact that all scientific tests ever made show that under the most favorable conditions arc lamps have never exceeded one fourth this rating, and in practical operation seldom attain an average of one-twentieth the candle power stated.

To this inexcusable exaggeration may properly be attributed the phenomenal success of promoters in securing street lighting contracts at prices greatly in excess of the previous charges for gas; and this useful subterfuge and imposition is still being practiced for the same purpose. But the matchless eloquence of the speculative promoter no longer dispels the ghastly glare, the deep shadows, or the frequently interrupted light of the arc lamp. The craze is at an end, the cost is being counted, and reputable electricians are themselves now making an earnest effort to undo the wrong.

The editor of the *Electric World*, in issue of April 29, 1898, in commenting upon the fallacy of longer continuing the absord rating of 2,000 candle power, says:

"As a matter of fact, all attempts to measure what is usually termed actual candle power of arc lamps have been disastrous failures."

While this statement is substantially correct, it is nevertheless true that a sufficicent number of scientific tests have been made to clearly establish the grossly exaggerated and deceptive claims of its promoters.

Even in the tests made, with no view to falsification, the report has usually been based on its most intense rays, which we all know very widely in practical operation, due to the variations in volume of current supplied, the character of the carbon, the length of the arc, etc., so that while little dependence can be placed upon even the few photometric tests made, they have at least scientifically determined that the mean candle power does not exceed one-third of the maximum, which maximum in no case has been found to exceed one fourth the long claimed candle power. The origin of this claim has been repudiated by our English cousins, who now assert that it was first made by an enterprising Yankee promotor of the Brush system; probably related to a distinguished "Electrical Expert" who recently gave to the Board of Public Works of New York city the following official opinion:

"The street lights are hung at street intersections, and each one throws its light in four directions. 2,000-candle power on each of the four streets cannot therefore be expected. An arc light which throws 500-candle power light along each of the four streets is a 2,000 candle power lamp, as called for by the contract."

During the discussion over the report of a special committee of the National Electric Light Association upon this subject of rating, Prof. Anthony said:

"We cannot specify anything about candle power, and there is no use bringing up anything upon that point; all you want to specify is that you will furnish a lamp to use 450 watts. And there is no 450 watt lamp in use that will measure 2,000 candles in the direction of its greatest intensity, as other sources of light are measured. There is no 450 watt lamp that will give, when surrounded by a glass globe, 500 candles."

Prof. Rowland said:

"The proper way is to decide the amount of current, and say nothing about the light, and then if they want to know how many candle power of light it is, I hope you will be honest enough to say that it is about 500 candle power."

Mr. Brophy:

"It is unfortunate that the term 2,000-candle power was ever applied to an arc lamp; bury out of sight forever the term '2,000-candle power'."

Prof. Thompson:

"The spherical candle power of arc lights would, therefore, be only a fraction of the rated candle power. For this reason the term 2,000-candle power arc has little significance as indicating the illuminating power. It is a convention only, and a very poor one at that."

The *English Electrician*, in commenting upon this condition, says:

"The Brush Company was the first to rate the ordinary arc lamp at 2,000 candle power, and though vigorously denied by some respectable electricians, the Brush Company, finding it paid, stuck to the trick, and has retained this exaggerated rating up to the present time."

Driven from such ridiculous exaggerations, by common sense observations, the promoters of this system are now claiming immunity from merited criticism, by asserting the legitimacy of using focusing apparatus to aid in supporting their absurd claims. But even these efforts, such as have been made by Trotter and Holophane, to introduce a globe with prismatic corrugations for decreasing the intensity of the light, and increasing its diffusibility, have not proven satisfactory, in either theory or practice.

Actual Practical Tests.—Quite recently, by means of a specially constituted photometer, a test was made of the candle power of an arc lamp on circuit in actual practical use, selected only with a view to the convenience of its location, from which the following results were obtained:

	7:30 P.M. 82.5 C. P.	
7:32 P.M. 60.0 C. P.	7:35 P.M. 47.4 C. P.	7:37 P.M. 65.4 C. P.
7:39 P.M. 51.0 C. P.	7:41 P.M. 105.6 C. P.	7:43 P.M. 40.2 C. P.
7:45 P.M. 199.0 C. P.	7:46 P.M. 226.0 C. P.	7:48 P.M. 124.2 C. P.
	7:49 P.M. 60.0 C. P.	

Showing variations, within a period of 17 minutes, ranging from 40.2 to 226 candle power, and a general average of but 96.5 candle power.

At the same time a test of voltage was made, and found to vary from 26 to 30, and an average of 28 volts in one case, and 32 in another, or an average of all tests of 30 volts; which, being multiplied by 9.6 amperes, showed a delivery of 288 watts, in lieu of 460 watts required by the furnishing company's contract, or but 62-100 of the city's contract requirements, and for which service the city is now paying $84.90 per annum. Which conditions, upon being analyzed, present the following rather startling but truthful deductions:

1st. The city is receiving and paying for a light shown to be less than 1-20 the candle power called for in the contract.

2d. If the "candle power is to be ignored under the misleading term "nominal," certainly the "wattage" is an exact and well-defined obligation calling for specific performance. The practical economic deductions are that the city is paying substantially twice as much as it should for the volume of current received; a condition which, when considered from a financial standpoint, presents the following rather remarkable result:

The Edison Company is now furnishing 3,325 so-called 2,000 candle power lamps, and under its existing contract is specifically required to furnish thereto 460 watts during 3,820 hours per year, or (3,325 x 3,820 x 460) a total of 5,842,690 kilowatt hours, for which they receive $84.90 per lamp, or a total of $282,292.50.

They are actually supplying but 288 watts, and therefore furnishing a total of (3,325 x 3,820 x 288) but 3,658,032 kilowatt hours, proportionally worth but $176,739.30. Or in other words, the city is to-day paying the Edison Company $105,553.20 per year in excess of its contract obligations. Or in still other words it is paying $84 90 per lamp having an electrical supply value of but $53.16. Or, reversing the order of calculation, if the service now being rendered is worth $84.90 per lamp, the service called for by the specific provisions of the contract would be worth proportionally $135.60 per lamp, or call for a total expenditure of $451,202.50.

A condition brought about by the infectious influences of the "electric light craze," which swept over the country like a cyclone in the 80's, during which a contract was entered into for the substitution of arc lamps, first lighted March 1st, 1893, and gradually extended until 11,962 gas and gasoline lamps, costing $210,663.50, have been replaced by 3,325 so-called 2,000-candle power arc lamps—at an increased cost of $71,629—a greater number in proportion to population than any other city in the United States, with the generally conceded result, that proportionate to cost, it is the worst lighted city in America.

Scientific Shop Tests.—Prof. Thomas French, Jr., of the University of Cincinnati, was employed in October, 1898, to make a photometric test of several new and perfectly conditioned arc lamps. In regard to which he says:

"In the calculation of candle power, from observations with the Bunsen photometer, application is made of the law of inverse squares, which asserts that the intensity of the illumination produced on a given surface by light emanating from a given point varies inversely as the square of the distance of the given surface from the given point of light. When it is an open arc light, without a globe of any kind, the assumed condition of light emanating from a point is reasonably well fulfilled. The correct photometry, however, of even this open arc is generally admitted to be a most difficult problem owing to the variation of intensity in the different angular positions."

Such tests show, with a supplied electrical energy of 460 watts, a candle power varying during the brief period of testing from 72.8 to 141 3, and giving as the average of 10 tests 92.29-candle power. Another series of tests, made under slightly different conditions and another type of lamp, gave with the same expenditure of electrical energy an average of 236-candle power.

Assuming the average of these several tests to be 164 1-candle power with 460 watts, if the supply of electrical energy had been reduced to that which was actually being delivered to the public lamps—288 watts—the candle power would have been reduced to substantially less than 100 candle power, thus completely verifying the results of the actual practical test first recited.

The degree of public dissatisfaction with this character of municipal lighting is now not only evidenced by general complaints of ineffectiveness but by such public protests as the following, signed by every resident and property holder along the avenue to which it refers:

CINCINNATI, April 27, 1899.

To the Honorable Board of City Affairs, City Hall—Gentlemen: We, the undersigned citizens, property holders and taxpayers residing on Grandin Road, have the honor to respectfully but earnestly protest against the substitution of arc electric lights for the present system of gas lighting on said thoroughfare.

The concentration of light at certain points, as with the dazzling arc electric lamps, is objectionable and very annoying to those residing near, and affords little or no light to those more distant.

The more even distribution of light, obtained by the use of less powerful lights at shorter distances over the entire area to be lighted, without excess at one point or absence of light at another, is the most desirable system of street lighting. The inequality, variability and uncertainties of the arc lights make them very undesirable, and seem to call for an unwarranted increase in cost of lighting without compensating advantages to the taxpayer.

If such additional cost could be applied to the substitution of Welsbach lamps for the present flat flame burners, the change would be most acceptable; but if this cannot be done we earnestly pray that the present system of gas lighting be continued in preference to the arc electric lights.

Not only are the numerous inherent defects of arc electric lighting obvious to all, but it is now apparent that the underlying principles of an intensely concentrated light and intermediate zones of darkness, coupled with variable and uncertain rays of constantly changing luminosity, are more objectionable than would be the absence of all light. As the necessity for light over the entire area of any given thoroughfare is as great as at any given point, the even and equal distribution of any given volume of light is the problem to be solved, and can be accomplished only by a greater divisibility. What would be thought of the sense and judgment of a manufacturer, who, having a room 400 feet long by 60 in width, throughout which an equality of light is not only desirable but necessary to its proper utilization, would concentrate his whole available light in one corner of the space; and yet this is just what the city is doing under the existing system of arc lighting.

It is a physiological fact that, under the influence of such a light, the pupil of the eye closes and cuts off some of the rays that would have reached the retina if more diffused, and as the effect of the illumination is proportionate not only to the intensity of its rays but also to the number, it naturally follows that increasing its intensity actually diminishes its utility for such purposes. The ideal object to be attained is an equality of light over the entire surface over which the necessities or tastes of the public require them to pass. Neither is it the purpose to turn night into day, but simply to afford that degree of illumination which will dispel a darkness that impairs either the safety or convenience of the pedestrian. We may, therefore, commend the opinion of Wm. M. Stine, who, in the *Electrical World* of February 23d, says:

"In view of these recited facts, it is little to be wondered at that the arc lamps, as ordinarily operated, are probably the most unsatisfactory means of illumination now in use."

The Welsbach or Incandescent Gas Burner.—Neither gas nor electric lighting came Minerva-like into existence fully armed and equipped for the battle of lights; with the exception that the older system developed more slowly in harmony with the times, the progress of gas and electricity has proceeded on substantially parallel lines. Neither can the Welsbach claim initial perfection, but the rapidity of its growth in public favor exceeds that of any other invention or discovery of modern times.

While it is not my present purpose to discuss either the technical mechanism of the burner or the purely scientific reasons for the development of its powers of incandescence, refractory nature, unusual conductivity, or chemical phenomena in the rare earths, of which the mantles are composed, I am prepared to bow in homage before the scientific and practical men who, by intense study, and patient investigation, along new lines, have developed this new and novel means of increasing the luminosity of our produce nearly ten-fold, through the heretofore unutilized element of heat, producing a light exceeding in practical utility that of any other system of lighting now known and rivalling in its economic results the difference between the "King's candles" and the first gas jet introduced to public favor.

While many attempts had been previously made, along lines looking to the utilization of the heating properties of gas, for the development of incandescent lights, it was not until 1872 that Carl Auer, then a pupil of the celebrated Prof. Bunsen at the Breslau University, became impressed with the belief that, consumed in the ordinary way, gas was not giving up its maximum energy, and that the heat generated through the instrumentality of a Bunsen burner ought to be utilized in aid of illumination by bringing to incandescence some refractory materials. A long series of experiments followed, which were not entirely successful; the materials which he first selected were volatilized under the intense heat necessary to produce incandescence. Some were brittle

and others warped by the unequal action of heat; but he persevered in his researches, aided by the investigations of Hertinger, Schneider, Rosenthal, Lungren, Clamond, Lewis and other scientists, each of whom contributed toward the final solution of the different problems involved.

Dr. Auer became renowned for his scientific attainments, and the University bestowed upon him a patent of nobility, under the title of Von Welsbach, referring to his native town; and since then he has been known as Carl Auer von Welsbach, which title has in turn been given to the light made possible by his scientific attainments, inspiring genius, and the patient labors with which he searched for and discovered the materials, or combination of materials, that compose the delicately woven fabric of refractory substance through the use of which a maximum volume of light with a minimum expenditure of heat is obtained.

The mantles first introduced in 1880, did not meet with universal approval, being capable of producing only a light of from 7 to 10 candle power, and mantle duration of not exceeding 600 hours' burning, but rapidly were new discoveries made and improvements added. The mantles of 1886 to 1888, while of the same general appearance as those now in use, were essentially different in the construction of burner and composition of mantle; since which its history has been one of constant developement and improvement in both illumination power and life of mantle. The standard of 20 in 1888, had been raised to 60 and 70 in 1891, and now there are mantles in practical use developing from 80 to 90 candle power, and in exceptional cases from 90 to 100 has been reached; while in one case coming under my personal observation the photometric test of a special burner showed 125-candle power, with a consumption of but 4 cubic feet of gas per hour. Even such results give promise of being rivaled in the near future by the researches of Wm. L. Voelker, of Elizabeth, N. J., whose claims appear to have been confirmed and favorably endorsed by such eminent scientists as Lewes, Bonsfield and Masterman, whose report asserts not only that the mantle possesses much greater longevity than any yet made, but that its lighting powers, instead of diminishing, steadily increase during the whole of its protracted life.

He says: "I took careful readings extending over 3,000 hours, and found that, starting with 64-candle power, and a consumption of 4.4 feet per hour, the Voelker mantle rose up to over 94 candle power in 2,700 hours. In addition to its fine light giving qualities this mantle is remarkable for its toughness Even after being burnt off it will stand upright without any support, and can be boxed and used again after hundreds of hours of work. This makes it peculiarly valuable for street lighting, or any place where there is much vibration."

Which present and prospective conditions, coupled with the complete absorption of heat and smokeless character of the products of consumption, remove two of the most frequently expressed objections to the use of gas, and render it suitable for use in the most delicately and beautifully decorated rooms, giving results in purity, beauty, brilliancy, steadiness, diffusibility, and economy unsurpassed by any other known method of artificial illumination.

The maximum efficiency and utility of the incandescent gas lamp depend first upon its ability, through a suitably constructed burner, to produce an intense heat; and second upon the comparative indestructibility of the mantle, through its ability to withstand the destructive effects of such applied heat. There is no question that there is a difference, in some instances a marked one, in the light giving power, or diffusive effect of the various types of incandescent mantles and burners now upon the market; but it is not my province to analyze the cause which produces such variable effects. Not only may unfavorable results arise from initial defects, but also, in so far as applied to street illumination, from collateral causes, such as carelessness in cleaning, vibration arising from instability of setting, and the contributory effects of lightning, storms, rains, dampness, etc. Many of which have been reduced to a minimum through the long series of experiments and experiences of the Welsbach Street Lighting Company of America, which has finally produced a composite lantern of the most perfect type, artistic in design, and beautiful in finish.

When we realize that 100 years have come and gone since Sir Humphry first announced his discovery of the practicability of arc lighting, and but two years have elapsed since the present perfect incandescent lamp has been introduced, how wonderful appears its growth in public favor. From the batswing to the Argand, the Wenham, the Siemens, the Lungren and various other types of regenerative lamps, giving from 10 to 12 candles per cubic foot of gas, was a vast stride, but yet in no way comparable to the astonishing developments of the Welsbach, with its light giving power of 25-candle power per foot of gas consumed, without material increase in cost of utilization, affording a soft, steady, brilliant light, emanating from a greatly enlarged surface, thus avoiding the painful effect of a strongly concentrated light branding its image on the retina of the eye.

Under such circumstances and conditions might it not be safe to assert that we are even now in the comparative infancy of development, and that many now present may yet live to see a light from gas that will be as much ahead of our present pride as it is ahead of the light of a century ago. Europe being the birthplace of the Welsbach, it is but natural that this is the field of its present greatest promotion and development in public illumination.

The city of Munich—the great art center of Europe—where all matters appertaining to beauty and attractiveness receive most careful consideration, has replaced the ghastly glare of the electric lamps by over 7,000 Welsbachs.

Paris, made the show city of the world by turning night into day, has replaced the arc lights by incandescents along its principal thoroughfares. The Avenue de l'Opera, the most prominent, the Bois de Boulogne, the most central, and the Champs Elysees, the handsomest boulevard in the world, all heretofore lighted by the erratic and uncertain electrical rays, now rejoice in the soft, warm glow of the Welsbach.

Berlin, the center of progress of the German empire, and now acknowledged to be the best lighted city in the world, has discarded arc lights, and replaced them by 35,000 incandescent gas burners.

Liverpool has, after thorough investigation, shut down its own municipal electric lighting service, and entered into a contract with its local Gas Company for lighting its streets with the incandescent burners. On which subject the Superintendent of Public Lighting of that city says:

"Seeing that the cost of lighting the streets of Liverpool with electricity is six times greater than that of gas, and that the Gas Light Company has ordered the whole of the city to be lighted with incandescent burners, there can be no doubt about its being the most satisfactory and economical system."

Bolton, finding that the cost of incandescent lighting of an equally satisfactory character was but £127 per mile, as compared with £546 for electricity, has followed Liverpool's example.

The streets of Glasgow, Edinburg, Leith, Naples, Weisbaden, in fact almost every prominent city of Europe, recognizing the coming economic revolution in lighting systems, has already entered upon, or is about to inaugurate, the incandescent gas system in place of the now generally admitted obsolete arc lamps, with their deficient and variable illuminating power, frequently interrupted current and dark shadows, which have proved so objectionable and dangerous.

The principal cities of the United States are following their example through a gradual but rapidly growing recognition of the incomparable advantages of this new system. From New York, Brooklyn, Philadelphia, Baltimore, New Haven, Bridgeport, St. Louis, Cleveland, Cambridge, Washington, Worcester, Springfield, Richmond, Grand Rapids, Omaha and other cities, east and west, come only words of hearty commendation.

In Cincinnati.—For the purpose of affording an object lesson of the efficiency of the incandescent system in the lighting of public thoroughfares, the municipal authorities authorized their installation on three of the main suburban avenues of the city—Clifton, Ludlow and Main avenues, Avondale—a total distance of 24,600 feet, or 4.65 miles, on which are located 204 Welsbach lamps, averaging 120½ feet apart, containing double burners at intersections and single ones intermediate, or a total of 260 single lights, first lighted December 5th, since which they have rendered service with every evidence of public commendation—voiced by the daily press in the following terms, the *Enquirer* saying:

"Main avenue in Avondale is certainly well lighted and the residents of that enterprising suburb are so thoroughly in love with the new lights that they violently oppose any suggestion of a return to the old system or to a substitution by electricity."

The *Commercial's* report of a personal inspection:

"At the corner of Shillito street, where the electric lamps have been replaced by the Welsbach, the contrast was striking. The electric lights cast long, dark shadows, which swayed and danced as the wind blew, and in the middle of each square there was deep darkness. But on entering the district lighted by the Welsbachs a change took place. The lamps, placed on ordinary posts, cast a bright, white light across the wide avenue, and the rays of one met those of another, so that there is no portion of the avenue that is not perfectly illuminated, producing an effect that was remarkable in the entire absence of shadows,

the light from each lamp extending until it met the rays from the other lamps, thus eliminating one of the greatest annoyances to those who are in the habit of driving horses after nightfall."

I feel justified in saying that the existing contract for electric lighting, entered into May 31st, 1892, for a period of 10 years, and therefore only 2 years longer to run, alone prevents the universal adoption of this new system to the lighting of all our public thoroughfares. As an evidence of the favor with which it has been received, I submit the following copy of a protest signed by every resident of an avenue that for a time enjoyed the advantages of the new system:

CINCINNATI, March 8, 1899.

To the Honorable Board of City Affairs, City of Cincinnati—Gentlemen: Having been advised that your Honorable Board has seen proper to grant to the Edison Electric Light Company a permit to erect carrying poles throughout what is known as the Seventh District, comprising the territory in which we reside.

Now, therefore, we, the undersigned property holders and residents on Fairfield avenue, represent that this avenue, having been lighted for the past six months by Welsbach lamps, we have had an object lesson of its superiority over any other known system of street illumination. In steadiness, constancy, uniformity, equality and brilliancy they are in striking contrast with directly the opposite qualities and most unsatisfactory service furnished by the Edison Electric Light Company.

Therefore, we earnestly petition and pray that no permit be given the Edison Company to erect poles or furnish electric lights on said avenue; but upon the contrary that the present system of lighting with incandescent gas burners be continued in preference thereto.

And now, casting aside for the time being all considerations of the superiority of the new system, we approach the equally important question of the comparative economic advantages, which so strongly appeal to the common sense judgment of the already overburdened taxpayer.

We first take the liberty of here inserting an editorial which appeared in the *Times Star*, October 18th, 1898, entitled "Extravagance in Public Illumination":

"It costs Cincinnati some $40,000 per annum more to light the districts now lighted by electricity than it cost to light them by gas. When the Sixth district, which is now being equipped for electric lighting, has electricity substituted for gas, $13,000 more per annum will be added to the tax burden of the city. What are known as the Seventh, Eighth and Ninth districts are strictly suburban districts, as is the Sixth. When they are equipped with poles and lamps and are all ready for substituting elcetricity for gas or gasoline, $54,000 more per annum will be added on to the tax burden of the people of Cincinnati.

"It is estimated that when Clifton, Avondale, Westwood and other newly annexed territory are all equipped, in accordance with the ordinance authorizing electric lighting, Cincinnati will pay $160,000 annually more for illumination by electricity than is paid for illumination by gas, which addition amounts to about 88 cents on every $1,000 taxable property in the city of Cincinnati. The appraised value of property in the downtown business districts is proportionately much higher than is the appraisement in the suburbs. The burden of this increased taxation, therefore, falls most heavily upon the business districts, districts that are the least liable to bear the burden, if for no other reason than because the appraised valuations are so much higher than they are in the suburbs.

"The reasons for extra illumination in the business districts are manifest, but it is not so clear that the hills and dales, the forests and shrubbery of the suburbs should be made brilliant by this expensive agent of illumination. This is the view the practical business governments of Paris, Berlin, Philadelphia, New York, Brooklyn and other large cities have taken, and they have so contracted that the superior lights, if they are superior, are confined to the business and thickly settled districts. The suburbs are suffered to wag along with gas or gasoline illumination. In this economical age, when men make their calculations on the basis of one fourth or one eighth of 1 per cent., it would seem eminently fit and proper that some effort be made to curtail the cost of street illumination rather than to constantly increase it."

Which is but one of innumerable articles which have appeared in the Cincinnati press condemning the system and deprecating its excessive cost.

From March 1st, 1893, to March 1st, 1900, the Edison Company installed 3,325 arc lamps, thereby displacing 9,740 gas and 2,222 gasoline lamps. The comparative annual cost of the two systems of illumination at present contract prices is as follows:

Arc lamps, 3,325 at $84 9		$282,292 50
Gas lamps, 9,740 at $18	$175,222 60	210,663.50
Gasoline lamps, 2,222 at $15.85	35,440.90	

Showing the excess in cost of electric lighting already amounts to $71,629.00 per annum, or 34 per cent., which equals 35.8 cents on each $1,000 of tax duplicate

No other city in the United States has shown, in comparison to population, any such profligacy in the expenditure of public funds toward the promotion of a costly and fast vanishing "fad." The following table shows the number of arc lamps per 100,000 population in all the principal cities of this country, containing over this population:

	Cincinnati.....911	
Denver 731	Boston.....487	Toledo.....300
Newark.....695	Philadelphia.....475	New York.....203
Buffalo.....660	Milwaukee.....439	Washington 183
Pittsburg.....600	Indianapolis.....432	Omaha.....172
Louisville.....567	St. Louis.....400	Cleveland..... 99
New Orleans.....503	Minneapolis.....310	Jersey City..... 90
Providence.....500	Baltimore.....308	St. Paul..... 88
	Chicago..... 71	

A mathematical calculation, based upon the well known law governing the transmission of light rays, shows the following comparative results. On a single square 400 feet in length, lighted in the first instance by arc electric lights at each intersection, varying in candle power from 40 to 226, and in the second instance by 4 equi-distant incandescent gas lamps, with burners shown by stated tests to possess an inital efficiency of 88 32, and after 624 hours use dropping to 78.56-candle power, or showing an average during period of two months' use of unvarying 83.4-candle power.

In such cases the total volume of light distributed over the entire surface will, in the first instance, amount to approximately 67,200, and in the second to 151,040 candle power. Or, in other words, from four Welsbach lamps thus placed may be obtained a total illuminating effect exceeding double that afforded by the arc electric lamps.

And this at a comparative cost of $72 for gas, and $169.80 for electricity. And if in addition we take into consideration the illuminating effect, or actual utility, their comparative cost will be as $72 is to $381.65 for the same volume of light.

The 19th century has properly been claimed as an age of electrical development, but may we not also claim that it has been equally noted for the marvelous advances made in methods of illumination through incandescence. With the advent of the former came the conviction that civilization had reached the limit of its progress in artificial illumination; and the world rested secure in this belief until the introduction of the incandescent gas light, which shed its beautiful, subdued, but far-reaching rays over the dark shadows of the light it is now superseding. A light that has excited the enthusiasm of the most indifferent, and the admiration of the most difficult to please; one that not only gives a better light at less cost, but one that is freed from the objectionable features and annoyances of frequently varying degrees of intensity, suddenly interrupted service, or total extinction, due to the breaking of a wire, the burning out of an armature, the slipping of a belt, or the thousand and one station accidents—only too familiar to those who like myself have in charge an electrical annex—which must necessarily impair the value of any service, which depends for its perfection upon the constant and continuous operation of delicate and complicated machinery.

Thus the passing days bring with them not only new discoveries but new methods and fads; the favorite of to-day may to-morrow be relegated to the rear by the progress of science and constantly increasing intelligence of the masses. But until that time comes,

"Let thy servant depart in peace, for mine eyes have seen the glory of the coming of the Lord."

Discussion.

The President—We must certainly thank our worthy Secretary for his persistence with General Hickenlooper to the point of getting this most valuable paper from him. As the General says, it is pretty hard on some of us who have both gas and electric interests to handle, but the growth of gas street lighting the last few years has been great. I understand Mr. Dickey has been putting in some Welsbach lights in Dayton. We would like to know what success he has had with them.

Mr. R. R. Dickey—We have had a number on trial in our city for perhaps 18 months or 2 years and they have proved very satisfactory. Residents on a number of streets want them, but owing to existing

conditions we have not been able to supply their wants. They yield unquestionably an excellent light, and I desire, in concluding what I have to say, to join with the President in thanking Gen. Hickenlooper for his most excellent paper.

The President—I believe Mr. McDonald, of Louisville, has also had some experience in that line. I will call upon him.

Mr. McDonald—No, Mr. President, I do not believe I have anything to say upon this subject. Gen. Hickenlooper's paper is so complete that I do not think anyone from a scientific standpoint could add anything to it. Two considerations, however, were probably omitted merely because they were so obvious. As far as the public is concerned, this is an excellent brief on one side of the case. I would like to suggest that one of the principal advantages, as it appears to me, to be derived from the use of gas as a means of street lighting, is that, the lamps being placed low down, the foliage of the trees does not obstruct the light, and being placed at frequent intervals light is also thrown into alleys that would otherwise be entirely dark. Those are the only two considerations which I can think of that are not specifically mentioned in the paper. While they are hinted at, and are obvious from the other conditions stated, nevertheless they are not brought out as clearly as I would like to bring them out, if I were talking to a gas and water committee.

The President—As Mr. Cline has had some experience on this subject we would like to hear from him.

Mr. J. W. R. Cline—I first want to extend to Gen. Hickenlooper my personal thanks for his valuable paper. We are all under obligations to him I think for this most able and exhaustive treatment of the subject. The General never does anything by halves, and not only are we under obligations to him for this paper but the public at large I think are equally indebted to him for it. The time will soon come when his prophesy will be verified in the Welsbach street lighting of this country. That has been my experience in the last 2½ years. The light in Springfield has proved a perfect success I might say. That is evidenced by the fact that there has not been a petition presented to the Board of Public Affairs of our city for electric lighting since the Welsbach lights were introduced. But, on the other hand, the Board has been flooded with petitions for the Welsbach light, and the only reason they have not been supplied is because the Board has not the money to do it. I have nothing further to say upon the subject unless it be to state the fact that we have now about 325 of the Welsbach lights in Springfield and it will not be long until every open flame burner in the City of Springfield is supplied with a Welsbach light.

Mr. H. Wilkiemeyer, Evansville, Ind.—Mr. President, the subject pre sented so strongly by Gen. Hickenlooper is an ever interesting one. I cannot bring any new thoughts to you on this subject, and what I might say would only be a repetition of those presented by me at the former meetings at which Welsbach street lighting has been discussed. After a use of more than six years of the Welsbach on the streets of our city, the people have grown so accustomed to them that when a light is solicited it is taken for granted a Welsbach light will be furnished. The Welsbach street lamp is also a constant ocular demonstration to the people along the streets lighted with it of what gas can do, which, with judicious advertising, showing the cost per hour of the Welsbach burner, will bring in a rich harvest of new consumers.

The President—I think Mr. Franklin, of Cincinnati, has had considerable practical experience with this subject, and I am sure that the members would be glad to hear from him.

Gen. Hickenlooper—I would say, Mr. Chairman, regarding Mr. Franklin, that I hope the gentlemen present will not suppose he has opened up a gas appliance store here (referring to a number of exhibits displayed on an adjoining table), but has simply brought up for your information and study the appliances which his inventive genius and intelligence have made applicable to the better utilization of the Welsbach lamp. One of the principal objections, as you are all aware, to the Welsbach lamp has been the possibility of injury or damage through vibration. I think that Mr. Franklin, who is Superintendent of Distribution for the Cincinnati Gas Light and Coke Company, has overcome every possible objection in that line. In fact, in all lines he knows more, indeed, I may say he has forgotten more, about the practical utilization of gas and gas appliances than I ever hope to know, and I would esteem it a pleasure, and I think it may be profitable to the members present, to hear from the "Little Englishman."

Mr. Jno. Franklin, Cincinnati—Mr. President and Gentlemen: It affords me great pleasure I can assure you to meet with you here, but it would have afforded me greater pleasure had I been able to have demonstrated the efficiency of a number of new appliances, which I have with me, by the aid of gas, which I am sorry to say is a forgotten commodity in this hotel. The appliances refer to improvements for incandescent street lighting; and successfully overcome a number of difficulties that generally arise with this system and which no doubt will interest you. Some 2½ years ago it was my pleasure to receive from my superior officers an order to erect and equip with Welsbach burners suitable lamp posts and lanterns for the effective lighting of Lincoln Park, one of the many parks in and around Cincinnati. I lighted very effectually this park with 56 posts, single and double burners, about 70 burners in all, which attracted great attention, this being the first demonstration of the system of lighting in Cincinnati for outside public illumination. The posts were fitted up with the ordinary Bartlett boulevard globe, with the top and bottom of the lantern suitably arranged to protect the mantle from insects and heavy gusts of wind. This being the first attempt of the kind it was naturally crude, but it was the means of opening a new field for thought, experiment and practicability, and I have taken the greatest pleasure nursing this new system of lighting as a mother nurses her child, putting my heart and soul into it, devising the most effectual and practical methods for the successful operation of the coming light of the Twentieth Century. The most essential and necessary appliance is that to protect the frail mantle from shocks or sudden jars caused by traffic or heavy winds shaking the lantern with such momentum as to break or damage the mantle. I have here a drawing of a street lantern adopted for incandescent lighting showing sectional view, which I take pleasure in saying that the original has been in service for the last two years, proving most efficient. I do not want you to think for a moment, gentlemen, that I am endeavoring to condemn other lanterns in the market. At the time these lanterns were placed in the park the Welsbach Street Lighting Company of America had not placed its system in the market, hence the necessity for home production, which production I take pleasure in presenting. We have something like 350 incandescent lamps now in use in Cincinnati, 250 of which are of the Welsbach system, the remainder of our own production. The Welsbach lantern is as good as any on the market, but nevertheless I feel a pardonable pride in saying I consider this lantern, of which I am about to show you a drawing, just as good. This drawing to which I will refer I think is sufficiently large for all members to see. I will commence at the bottom. This is a cast iron cauliflower that rests on top of posts and supports the lantern proper. It is fastened to the post by the aid of these screws, thereby insuring safety. The screws on the top are intended for the purpose of keeping centrally located the ¾ stem. The lamp cock is arranged with a pilot light and slushing device, thereby enabling the slushing of lamp-stem without interfering with lantern proper. This globe holder is arranged with sliding partition to enable the lighter to insert his torch to light the pilot; he then turns the key of lamp-cock half on, lights the pilot which ignites the mantle; he then turns the key on full, which allows the pilot to be shut off and admits the gas on full to burner. The next and most important feature is the anti-vibrator, which is the most essential device for the economical handling of this system. I believe I can demonstrate more fully by the actual appliance which I have here. This illustrates the effective working of the vibrator which, as you see, is arranged with four diverging arms secured by means of screws to flange of chamber. The burner rests entirely on the springs so that any movement, no matter how small, is perceptible. This cup or chamber is sealed to prevent the escape of gas. You can see by the way I handle it it is next to impossible to jar the mantle, the action being so smooth and sensitive. You will notice as I tap the top part of this spring that the jar is not transmitted to the mantle, thereby proving a very effective method for its protection. This is the burner and is arranged by means of a needle valve to adjust the supply of gas suitable for the proper combustion of the flame coupled with the adjustable air chamber. The Bunsen part of burner is arranged by having the throat in center of Bunsen tube contracted to $\frac{3}{16}$ of an inch aperture and the ends of the tube $\frac{5}{8}$ of an inch. The principle proves very effective by reason of this contracted center in holding in suspense the gas and air until they become thoroughly mingled, so that when the mixture reaches the top of cap, having a gauze, the flame emitted, being of very high heating power, by reason of the combination and force given it by reason of gas orifice being a single hole, acts as a siphon drawing with it the necessary amount of air, thereby bringing the mantle to a high incandescence point. The actual photometric test of this burner, under a pressure of 3 8 with a consumption of 4.2 cubic feet without chimney, gave us 98.7-candle power with English mantle. The same burner with an 8-inch chimney gave us 122½-candle power under the same conditions.

Mr. Cline—With a double or single burner?

Mr. Franklin—Single burner. Now we come to the globe, which is

an ordinary tulip shaped one without the usual lip for supporting same, it being intended to rest on the holder. On the top of the globe is an enameled steel deflector, suitable for one or more burners, being fastened by means of brass screws and bolts with a band of 1-16 perforated brass around its outer edge. This band rests on top of globe thereby preventing insects from entering the interior of globe, but at the same time it is sufficiently open to allow the products of combustion to pass off. This chimney, which is of mica, is supported by the upright arms on the top of this deflector, and is used for three purposes: First, to assist in carrying off the products; second, to aid in bringing the refractory mantle to a higher state of incandescence; and, last, to place on the burner to protect the mantle from the elements while the globe is being washed. Next we have the iron crown or top which is held in position by four ⅜-inch rods, fastened by ⅜ inch bolts to cauliflower, having its top arranged for hinge, which is bolted to enameled steel top, which supports a 14 inch glass dome surrounded by an 8-inch copper canopy with double perforated partitions in its interior for the exclusion of insects and heavy gusts of wind. The canopy and glass dome are fastened by means of this 4-inch rod, which is screwed into this iron bridge, and the bridge is fastened to steel reflector top. On the upper part of this steel top are four pieces of pure rubber for the glass dome to rest upon, thereby allowing for expansion and contraction. This is very necessary from the fact that, when the top is thrown back for the purpose of removing the globe, the strain on the globe is relieved by the use of these cushions. In connection with this crown the outer edge is drilled with ⅜ inch holes, 4 inches apart at the lowest part of the outer eage, to allow the water to drain off, thereby keeping the globe from receiving the draining, which has proven a detriment in other styles of lanterns. I believe, gentlemen, this is all I can say in regard to street lighting. I have with me a number of photographs showing the different styles of incandescent lamps of 4 burner and 400 candle power each, which I feel will interest you. This is a lamp suitable for outside use for the lighting of store fronts, vestibules, railroad stations, freight depots—in fact anywhere that an increased illumination is desired. The consumption of these lamps is about 15 feet per hour, and will cost to the trade about $10 each. This style of lamp is intended for the purpose of lighting churches, halls, theaters and stores. The lamp hanging over there with the anti-vibrator on, is a lamp which I consider will fill a long felt want for the lighting of factories, printing offices, machine shops and any place where heavy vibrations are felt, and where it is impossible for mantles to last in places of this kind; but with this principle that trouble is entirely obviated. These lamps are handled by the Siemens Lungren Company, 409 Plum street, Cincinnati, Ohio. This small vibrator for Welsbach lamps, either with shade or globe or any of the other style of burners now in the market, is proving a very attractive feature, especially on fixtures in places where there is any probability of concussion or liability of mantles getting fractured. One other matter I wish to call your attention to, for I feel that all of you will be more or less interested in it. This does not relate as much to the subject of light as it does to caring for that part of the business that has heretofore proven a very expensive branch to the distribution department—that of the setting of meters and connections thereto. I do not care how good a mechanic you have in your employ, or how careful he is in performing his work of connecting the inlet side of the meter, especially if the service coming through foundation wall is below the meter to be set, it is next to impossible to take a ¾ inch light lead and bend it without the aid of some filament, without damaging or kinking your lead, especially if it is necessary to make a close bend. It may be that the first installation of the old style connection is placed in position in a very satisfactory way, but if it should be found necessary to disconnect this connection or to remove it from service it cannot be straightened and then replaced again without damaging it to that extent. Nine cases out of ten it will not only prove a detriment to the company, by not allowing the necessary gas to pass to the meter, but will prove a great annoyance to the consumer and also an expense to the company, which means sooner or later a new connection. If this is the case with ¾ inch it stands to reason that the larger the lead the more the damage. It is impossible to bend a connection by hand to bring the nail piece of connection in such position as to form a perfect connecting joint. The consequence is that the pliers are brought into service, and by putting the strain on nail piece above the coupling it is forced to its position this way, and not only ruins the connection but you are liable to break your pliers, which last year cost our company in the neighborhood of $65. This new connection, entirely obviates these difficulties by reason of its construction which I will explain. This end which connects to the inlet of the meter is a metal ¾-inch bend. The coupling on its outer edge is grooved to receive arm for the purpose of locking to the swivel band by means of a lock or seal, thereby preventing the tampering of coupling without releasing the arm, which cannot be released without removing the seal or lock. The lead pipe is soldered to this bend, filled with sand in shop and taken out in the position you now see it. The end connecting to the meter is left perfectly straight, so that in case it is found necessary to cut off a small portion it can easily be arranged to suit the conditions. In performing this duty all that is necessary, in case you have not got a saw with you or a turn pin, is to take out your knife, cut off the lead, take the round end of your pliers, after slipping the coupling over the lead, and by a series of rotary movements bell out the end of lead to that extent that the coupling will pass over the bell-shaped end of the lead. You can then place your meter cock on the service. This cock is arranged with male thread on the upper end, to suit this coupling just placed on lead pipe. At the upper end it is arranged to hold a leather washer, placed in the position to suit the arc of the bell end of the lead pipe, which, when the coupling is screwed on the meter cock, thus makes the connecting joints perfectly gas tight. The swivel arm which is riveted to the cock is placed in one of the grooves and the mouth of the swivel band placed into position locked or sealed as desired. You then have a complete, reliable and mechanical connection which with a little care will last a lifetime. By the use of this wrench it is impossible to damage the connection, but it fills the want of a pair of pliers for meter connection use and will last a lifetime. The expense to the distribution department of the Cincinnati Gas Light and Coke Company for pliers during 1898 was $65; during the year 1897 an accumulation of 4,160 pounds of lead was brought home, composed of meter connections damaged and useless. This statement may appear incredulous and you may imagine I am engaging in loud talk but, gentlemen, these are facts and cannot be denied. If I remember rightly it was about two years ago since this system went into force. During that time we have placed over 5,000 of these connections in use, and have yet to find the first damaged connection either in the shop or out. This connection is adapted to be placed in any position and will prove one of the economical appliances in use by the distribution departments of all gas companies. The proof of the pudding, gentlemen, is the eating of it. This connection will be placed on the market shortly and you will be advised by circular. If at any time you gentlemen desire any information in regard to these appliances I shall deem it a pleasure to give you all the assistance I can. (Applause.)

On motion of the Secretary, seconded by Mr. Penn, a hearty vote of thanks was tendered to General Hickenlooper for his most valuable and interesting paper.

Mr. John R. Lynn, of Portsmouth, O., then read his paper on

THE PRESENT STATUS OF FUEL GAS.

[For the text of Mr. Lynn's paper, see JOURNAL, March 26, p. 490.]

Discussion.

The President—Gentlemen, this is a subject in which we are all certainly deeply interested. I will call upon Mr. McDonald to open the discussion, as he has no doubt given it much consideration.

Mr. McDonald—Mr. President, I have both worked and talked on it a good deal, and I do not think I can say anything new on the subject that these gentlemen have not heard me say before. Of course, if I say anything I will try and have it true. One thing you can all set down as being a fact is that nobody will ever make gas out of coal which will be, heat for heat, equal to coal. In other words, a gas will never be made which can be used profitably for any purpose for which coal will do equally well. And it is nonsense to talk about the necessity of selling gas at 80 cents per 1,000 in order to compete with coal at present prices. There are other reasons, however, which can be used as a convincing argument in securing the use by the consumer of gas for fuel. Potent reasons are the matters of convenience, cleanliness and the opportunity afforded by the use of fuel gas of turning out your fire or starting it at will. Where these conveniences are to be desired the consumer will pay a price six or eight times the cost, heat for heat, of coal. One of the first requisites to the success of the sale of fuel gas is that the manager should make up his mind what can and what cannot be done. You cannot furnish fuel for boilers or furnaces and you cannot even furnish a steady fire for a hall stove that has to go 24 hours a day all winter long, but you can furnish fuel for cooking winter and summer. You can furnish fuel to heat water for bathing purposes and other domestic purposes in the house. You can furnish the occasional fire for the cool spring and fall days, and for the room which is used an hour or so in the morning and in the evening, and those purposes

alone would require any one of you to multiply the capacity of your plants by five if you attempted to fill the demand which can be created.

Mr. Doherty—Mr. Lynn says in his paper, "One ton of good bituminous coal, costing $2 under a boiler, the work of which is constant, is in practice equivalent to the total possible work of 25,000 cubic feet of average coal gas." Now, 25,000 cubic feet of coal gas, according to my figures, would be only equivalent in heating value to about 1,000 pounds of coal, and we all know that we can secure pretty close to 80 per cent. efficiency on boilers with coal and, of course, you cannot get over 100 per cent. efficiency with gas. Now if we reverse these figures and use gas in the gas engine, even assuming 20 feet of gas per horse power per hour and 3 pounds of coal per horse power, or that 20 feet of gas will be equivalent to 3 pounds of coal, that would be about 7,000 feet of gas to a ton of coal.

Mr. Lynn—I would say, Mr. President, in drawing up these figures I took the actual results of good bituminous coal under a boiler. These are the results of a test I made, and I gave the coal gas the full benefit of all the heat units that could possibly be developed.

Mr. Doherty—What boiler efficiency did you allow in making your test?

Mr. Lynn—I did not make any test of the boiler efficiency. I took the coal under a boiler that was arranged to make the test, and made a comparative test of several grades of coal. In making the comparison with coal gas I took the actual number of heat units.

Mr. Doherty—How did you measure your work done?

Mr. Lynn—So many pounds of water evaporated to a pound of coal.

Mr. Doherty—You must get a boiler efficiency then of less than 40 per cent. on your coal and 80 per cent. on the gas?

Mr. Lynn—I gave the coal gas the full benefit of all the heat it would possibly develop.

Mr. Doherty—The only matter I want to call attention to is that if anybody uses these figures I think they should be further verified, for I have not been able to secure a result equal to the one referred to by Mr. Lynn in his paper, namely, that 1 ton of good bituminous coal is in price equivalent to 25,000 cubic feet of coal gas. I think it would be nearer to 50,000 feet of gas.

Mr. Lynn—The language which I employed in making that statement explains itself. I said that in practice the coal was equivalent to that amount of coal gas, that is to the total possible work. I referred in my paper to the total possible work of 25,000 cubic feet of average coal gas.

Mr. Doherty—Yes, but the coal is possibly doing almost twice that much.

Mr. Lynn—You could get a higher heating efficiency certainly with coal gas than you could with coal.

Mr. Doherty—No; I think you would get a higher efficiency or you would get more total heat with your gas than with the coal. But if you take the ordinary efficiency you could not possibly get the same amount of work out of the 25,000 cubic feet of coal gas, and if you were figuring on this coal gas you would have to use about 50,000 cubic feet instead of 25,000.

Mr. McDonald—I will say for the information of Mr. Doherty, and possibly also for the information of Mr. Lynn, that 25,000 feet of gas to 1 ton of coal is accepted all over the gas fields. I presume in arriving at that result they do not take the theoretical heat units, but give the gas credit for the fact that there are no wages to be spent in utilizing it. As a matter of fact you can sell natural gas at 8 cents per 1,000 for boiler fuel as against coal at $2.

Mr. Doherty—He said coal gas and not natural gas.

Mr. McDonald—That would be about 65 one-hundredths of the value of natural gas.

Mr. Lynn—It runs in about the proportion of 7 to 10.

Mr. Stone—I had occasion during the last few months to look into this matter somewhat. In a paper read before the Western Gas Association, in 1896 or 1897—I have forgotten the name of its author—the figures were given that 180 gallons of oil, or 25,000 cubic feet of natural gas, or 35,000 cubic feet of coal gas or a ton of the best Ocean Mine coal were practically of the same value for use under a boiler. I am somewhat interested in this subject because I am connected with a manufacturing concern engaged in making forgings and we have been using oil for fuel for heating forgings, but the price of oil has advanced to such an extent that we have been thinking for some time of putting in a fuel gas process to take the place of the oil. I was requested to look pretty thoroughly into the matter, and during the past two months I have visited four or five fuel gas plants—industrial fuel gas plants which have been put in for manufacturing purposes—and I would like to support Mr. Lynn in his assertion that, at the present price of coal, coke and tar in this immediate vicinity, say within a radius of 100 miles, there is no soft coal water gas process at present that can make gas cheaper than we can make gas by the straight coal gas process. And the gas made by the straight coal gas process contains twice as much heat of course as the uncarburetted or soft coal water gas, and consequently it is that much better, or proportionately that much cheaper. There has been nothing discovered so far that is equal to it. To verify this I may state I have tried in vain to get propositions from four of the best firms making that sort of a plant to erect a plant to give a certain efficiency. In fact one of them in writing to me confessed it was impossible to compete under present conditions and circumstances.

Mr. Lynn—Good coal gas will develop about 750 heat units per cubic foot, and natural gas is generally rated at about 1,000 heat units. I would further state that Ontario natural gas was not capable of developing over 891 heat units per cubic foot, while the Ohio and Northwestern gas that went into Detroit for a number of years, towards the latter part of the time it was being distributed there, never developed over 840 heat units.

Mr. Whysall—Has any member present made an actual test by using coal gas under a boiler? It occurs to me that Mr. Lynn's statement that 25,000 cubic feet of coal gas is equivalent to a ton of coal at $2 is not far out of the way, as in the use of natural gas we find no difficulty in displacing a ton of coal with from 14,000 to 16,000 cubic feet of natural gas.

Gen. Hickenlooper—I simply desire to say that we made a very exhaustive test at the Cincinnati gas works regarding the comparative efficiency of coal gas. This test we made not only by ourselves, but through the agency of three selected experts who were absolutely disinterested, in order that there might be no question about the results, and they are confirmatory of Mr. Lynn's figures.

Mr. Doherty—In spite of the evidence to the contrary, as furnished by the gentlemen who have spoken and whose opinions I respect very much, I must still insist that 25,000 cubic feet of coal gas is not equivalent to a ton of good coal. A ton of good coal ought to contain practically 14,000 British thermal units per pound, or 28,000,000 British thermal units per ton. I have never seen coal gas that went 750 per foot—I think 650 is nearer right; but even at 750 it figures out here in dead cold figures 18,700 British thermal units, or less than two-thirds of the heating value for a ton of coal. Now we get every day, with any kind of fair conditions, using good coal, 70 per cent. efficiency of that coal in boiler work, and I will swear that you cannot get 100 per cent with gas; I doubt if you can get over 80 per cent. Therefore, no matter how many tests have been made, it is evident that we are either wrong as to the heating value which we give to coal and gas or else there have been some mistakes in these various tests. If gas has more of heating value in it than we have ordinarily assumed heretofore, I will be very glad to change my figures.

Mr. Lynn—I have never made a test of coal gas under boilers, but I have made a test of natural gas under boilers. I have forgotten just what the equivalent was, but it can be found in a paper[1] which I read before the Michigan Gas Association a year ago last month. The figures contained in that paper were the actual results of tests obtained under the same boiler with the various kinds of fuel.

Mr. Lloyd—I do not believe that these tests are of a great deal of practical value, for the reason that a boiler is ordinarily built for the use of coal, and gas is an entirely different article. Therefore, if we want to get the best results from gas for that purpose we would not use it for converting water into steam and then converting the steam into power, but we would convert the gas directly into power.

Mr. Lynn—With reference to Mr. Doherty's statement that good coal gas will not develop 750 heat units I desire to say that it will develop it. Perhaps Mr. Doherty never had any experience with good coal gas. (Laughter.)

On motion of Mr. McDonald a vote of thanks was tendered to Mr. Lynn for his excellent paper.

Mr. John D McIlhenny, of Philadelphia, Pa., then read the following paper on

PREPAYMENT METERS.

When invited by the Secretary of the Ohio Gas Light Association to write a paper upon the above subject, I hesitated to accept, and for two reasons: First, because able papers upon this subject have been read at recent meetings of other Associations, and followed by very general discussions; and, secondly, because I read a paper[2] on the same subject at your meeting in Springfield, in 1895. Upon considering, how-

1. "Importance of Proper Boiler Settings in Water Gas Plants," JOURNAL, March 14, 1899, p. 374.

2. See JOURNAL, March 25, 1895, p. 409.

ever, that some phases of the prepayment meter question may not as yet have been fully presented, and as the paper of 1895 was of a preliminary character, when but few meters of this type were in use in the United States, I was glad to do as he wished.

Now, definite results can be given instead of reasons or conjectures. During the past five years these meters have been introduced extensively, and are now a potent factor in the gas business.

One of the encouraging features of the gas business is that something always turns up by which the business can be continued and its usefulness enlarged. When electric lighting first made its advent, those in the gas business were discouraged as to the outlook. Very shortly, however, higher candle powers and cheaper methods of gas manufacture were produced. The use of gas for fuel purposes also began. Later on, as electricity became better established and was making inroads into the gas lighting business, the Welsbach light sprang forth. Were it not for this wonderful incandescent gas burner, electricity today would not consider gas a formidable rival in the lighting field.

The prepayment meter now is extending the sway of the gas business by popularizing the use of gas generally, and by opening a field not hitherto reached, namely, among the small householders. While the individual sales to the latter may be less than the general sales per meter, yet the aggregate represents a valuable addition to a year's output and profit.

We are aware of the general advantages of the prepayment meter, of the avoidance of the deposit system, of a business on a cash basis, and of the increase of business along existing lines of mains, and hence with a less proportion of additional leakage. We have also heard much of the use of these meters in large cities, but so far little has been said of their adoption by the smaller cities or towns, and where it has been thought they would not be practicable. I am prepared here to say, however, that the prepayment meter is as well adapted, and may be of more positive value to the gas company in a small town than to the company the output of which is in millions of feet per day.

In a city of ample population, money is made and spent with more ease and liberality than in lesser communities. The workmen and mechanics, and the large array of clerks and storekeepers, receive better compensation in cities than in towns. They also demand to a greater extent the comforts of life, of which gas is one.

The company having thousands of consumers can make iron-clad rules and enforce them with little difficulty. Large cities are much of a machine, and the integral parts become imbued with respect for its motions. The gas company numbering its consumers by the hundreds only can, but with difficulty, insist upon rigid rules for prompt payment, and with great hesitation cuts off a consumer. The officers of the company usually know the consumers personally. Any arbitrary action is made a general topic of conversation, and often arouses enmity. The custom of credits also prevails. In what small town is the statement not heard : "The people in our town are very slow pay!" For the payment of a single bill a collector will often make many calls, and be greeted with animadversions upon "soulless corporations;" and all for the payment of a bill the amount of which may not exceed one dollar. Such is but human nature.

If by some device the gas may be used and paid for at the time, and the importunity of collection be avoided, a more harmonious relation will exist between the company and the consumers. The superintendent, upon whose shoulders rest the cares of the company, from the manufacture of the gas and its sale to the collection of the bills, will look upon life with greater cheerfulness.

The first cost of the prepayment meter seems an obstacle to the small or moderate sized company, but, upon examining the matter, is not the extra cost warranted, and is it not soon returned to the company? No one hesitates to procure the usual meter in order to secure a consumer, so that we may consider only in the argument the extra cost involved in the prepayment meter. This, for the 3-light size is, say, $5 25, and, with the lock added at 30 cents, makes the total extra outlay $5.55. Six per cent. interest on this investment is 33.3 cents, and, if we allow 10 per cent. for depreciation, or 55.5 cents (far more than actually occurs) a total is obtained of 88 8 cents. If that amount be charged up each year to profit and loss, the interest item becomes less and less, so that the average charge for the 10 years would be less than the figure first given. To be upon the safe side, however, and allow for contingencies, we will suppose that an annual charge be made of $1, or a little over 18 per cent. The question then is, "Will it pay?"

Gas companies lose something every year through unpaid bills. How many companies can say that they lose less than $150 a year? If, by using prepayment meters, two-thirds of that sum be saved, this saving, $100, will just represent the fixed charges as called for by 100 meters.

Where the discount allowed on the regular bills is not given with prepayment meters, this difference, even though small per 1,000 feet, yet will represent quite a sum to the company at the end of a year. In some cases, it will more than offset any yearly profit and loss charge for the prepayment meter installment. Setting the meters at net or full prices varies according to local conditions, though the general plan is at net rates.

Consider also the amount of time spent in collecting bills from delinquent customers. Some consumers must be visited regularly every month, and many more than once a month. If a collector be employed, an average of an hour for a call may be required. Allowing only $6 per week wages, this means 10 cents an hour, and, at one call per month, amounts to $1.20 a year. It may be said that this collection costs nothing—that the same employees must be kept in any event. It, however, does cost something, for if the time be not so occupied it may be spent more profitably in canvassing and soliciting new business, either for light or fuel purposes, in attending to minor complaints or doing other work which will produce a positive result.

Radical methods are often employed to introduce gas ranges, frequently with considerable immediate loss. Very often the same amount would almost or entirely defray the extra cost in a prepayment meter. Would not the business brought by the latter, and existing throughout the year, be of equal value?

The actual results derived from prepayment meters are interesting. The writer of this paper is connected with a small gas company in an Atlantic Coast State, where 700 meters altogether are set, and the following is a statement of the prepayment meters in use and the sales therefrom during the year 1899 :

1899.	No. Meters.	Cubic Feet.	Amt. at Rate.	Amt. Collected.
January 1st	53	238,900	$378.88	$379.55
February 1st	53	202,100	317.25	317.50
March 1st	53	187,300	285.75	289.90
April 1st	59	183,400	286.93	282.80
May 1st	63	172,600	261.64	270.85
June 1st	67	148,100	228.50	234.25
July 1st	70	161,200	238.65	239.80
August 1st	75	141,300	201.52	213.15
September 1st	77	162,200	233.16	237.70
October 1st	80	163,300	243.52	242.10
November 1st	82	215,900	326.92	336.35
December 1st	86	259,500	386.24	387.15
		2,235,800	$3,388.96	$3,431.10

It will be observed that the sales in January from 53 meters amounted to $378.88, while in December, at the end of the year, the sales from 86 meters amounted to but $386.24. This is accounted for by the fact that in the spring a reduction was made in the price of gas; also, in December, a hotel which used gas through 20 light prepayment meter, was closed for alterations.

The excess of money collected over the amount due at the rate per 1,000 is caused by unconsumed credits.

The average revenue per meter in the month of July was $3.40, while in December the average revenue per meter was $4.49. These results are unusually good, and can hardly be looked for under ordinary conditions. They are caused in this case by the fact that several large users of gas previously of poor pay have been changed over to the prepayment system. One small hotel alone the year previously, through failure, caused a loss of $75.

The extra investment in the prepayment meters was certainly justified to the company in the excellent results produced, showing, as above seen for the year, sales of 2,235,800 cubic feet, with a revenue of $3,388.96. An annual charge of even more than $1 per prepayment meter would be a small item compared to the returns.

It is the idea of this company to set prepayment meters with all small consumers possible and with all new business except that of the very best class. The company stands well in the community and without any friction. The prepayment meter has largely contributed to this result.

Inquiry was made from the superintendent of another company having 900 to 1,000 meters set, which has been using prepayment meters, and the reply in full is as follows :

"In reply to your inquiry regarding our experience with prepayment meters, I beg to inform you that it is eminently satisfactory to us and to our customers who are using them. We have 203 in use, and the average receipts of the same will net us $17 each per year. They enable us to reach the people of slender means, as the payment for the gas is

as easy as the purchase of coal oil from the store, and they are realizing that with the use of the Welsbach lamp a better and safer light can be obtained at the same cost as for oil.

"There are other classes of customers that the prepayment meter is adapted for, the customer who is constantly moving from place to place, the one who is suspicious of everybody, and especially of gas men; and last, but not least, the dead beat who won't pay where payment can be avoided. To sum up, our experience with the prepayment meter is that it has gained us customers that without it we could not get, and some that we could get but would not have with the straight meter—and that now our relations with the users of the prepayment meters are better, no complaints of excessive bills, and these people are advertising and popularizing the use of gas. We would use them to a greater extent if their introduction were less costly."

Can it not be said that the results derived amply warranted the extra expenditure for prepayment meters? It is safe to say they would not now be parted with for far more than their cost. Suppose even that the average revenue from the prepayment meters had been but $1 per month, or $12 yearly. Would this not have paid? The old saying may apply:

"Keep thy shop and thy shop will keep thee;
Light gains make heavy purses."

The population in the two towns given is about 15,000 each, but good results can also be accomplished with prepayment meters in much smaller places. In a certain town of 4,000 people 215 prepayment meters are in use out of a total of 700, the year's output being about 10,000,000 cubic feet, at prices of $1.50 for light and $1.25 for fuel. This company is so well pleased with the results of the prepayment meters that it is now setting them entirely, the expectation this year being to put in not less than 100 additional meters.

This exhibition is very interesting aside from the question of prepayment meters, and most encouraging and gratifying to those who are in the gas business. It shows what can be accomplished, even in a small place, by persistent activity in increasing the use of gas. The bookkeeping in connection with prepayment meters involves no difficulty. While there are several systems in use, the one here given may be taken as a type. There should be a special prepayment ledger, showing the detailed history of each consumer. The collector is provided with a number of coin envelopes, which are printed thus:

.....Gas Company.
Prepayment Meter No.....
Date.....
Name.....
Statement.....
.....
Amount.....
Collector.....

The information called for is written upon them, and the money placed in the envelope, which is then sealed. The collector is instructed to be on the lookout for bad coins as the money is removed from the box. When the envelopes are opened in the office any defect in this regard may be detected. From the envelopes the information is then entered upon the ledger, a sample page of which is shown:

Prepayment Meter Ledger.

Consumer's Name..... No. Meter..... Size Meter.....

Date.	Rate.	State of Meter.	Net Dif. Cubic Feet.	Amount at Rate.	Amount Collected.	Date Collected.	Collector.	Remarks
Totals..								
Totals..								

This displays at once any discrepancy in the accounts. Ruling is provided so that the accounts may be totalled every six months, and the back pages of the same book may be used for groupings. By this system the gas due upon credits is not taken into account. When, however, a fair excess of cash is seen it can be assumed that the company will receive all its dues, and more complicated bookkeeping is avoided. When greater exactness is desired, and especially by large companies, a system may be followed of "making change" with the meter; that is, the meter reader, using a book or card system, can see the statement of the previous reading and hence the amount of gas consumed. If the consumer has an unconsumed amount to his credit, the balance due him is returned to the money box of the meter, and the amount collected, as well as the amount of return noted upon the card or book. At the next reading the change left is taken into account, and so on. By this method cash is brought into the office only for the amount of gas actually consumed. This system can be more easily followed when gas is sold for even amounts, so that the reader can readily reach results; for instance, when the price of gas is net $1 per 1,000 cubic feet. At other rates it is more difficult to make calculations, or would involve the carrying of a figured chart.

One man may both take the money and the statements of the meters, though it is a good plan to alternate collectors. When alternated, errors and irregularities would show, or involve conspiracy between the collectors. There is very little danger in this, and the men may also be put under a small bond. As no bills are rendered with prepayment meters, the office work is relieved at the first of each month.

From experience with prepayment meters it has been found advisable to encourage the consumers to always keep a fair amount of gas purchased ahead. The annoyance then of the lights being diminished at inopportune times is avoided, and the consumer is generally better satisfied with the use of gas. Each coin buys its full worth, no matter at what point inserted, so no loss whatever is incurred in not letting the meter run back to zero. Mechanically this is also of advantage to the meter, as in any mechanism a greater strain is involved at extreme limits.

In general, prepayment meters in this country have been quite satisfactory from the mechanical standpoint. The troubles found with the first introduced have been greatly removed, and the complaints from defects with the meters are quite few. For instance, in one section of a large city, where about 3,000 prepayment meters are in use, the number of meters brought in due to prepayment difficulties does not average more than five or six per month. The population in that section is almost entirely of the working class and not of the best character. The percentage of complaints may be increased when the meters have been in use for a longer period, but hardly to a radical extent. Simplicity of mechanism has generally been striven for, and any fairly competent workman can make substitution of injured parts.

The robbery of prepayment meters has not proved to be the bugbear feared. There may be a few cases when first introduced. The meter is set under the control of the householder, and the general public has not entry to it. The regular index of the meter will show that gas has been consumed, whether paid for or not. Breaking a cash box is burglary, and very different from the non-payment of an ordinary gas bill. When money has been removed or bad coins used, the consumer will make restitution rather than run the risk of exposure.

One novel use to which prepayment meters have been applied is to work up unpaid bills of poor pay or cut off consumers. The meter is set, by agreement with the consumer, at a higher rate per 1,000 than the regular rate. The amount collected in excess is credited to the old account until that is met, when adjustment is then made to the ruling prices.

Some of the members of this Association are interested in supplying natural gas. Prepayment meters are well qualified for this purpose, and with them consumers can be obtained from whom otherwise a heavy deposit would be necessary, as natural gas is generally employed for all household purposes. The 20 light size is the one most used. One company, having set over 1,000 of them, receives an average of about $21 per year revenue per meter.

With natural gas, the selling price being low, say 25 cents per 1,000, no discount is allowed through the prepayment meters. A discount of 10 per cent. is but a trifle at the time to the consumer, and yet amounts to a safe sum for the company. It will provide a fund by which the extra cost of the prepayment will be returned in a few years. With natural gas users, a minimum rate of say $1 per month can easily be made a condition to the supply.

In England, where prepayment meters were first introduced, the results are worthy of note and may be of value to us.

The following is obtained from an address delivered by Mr. H. O. Eldridge, of Tottenham, a few months ago, before the Southern District Association of Gas Engineers and Managers.

Tottenham, a suburb of London, commenced with prepayment, or, as there called, automatic meters, in 1893, at the end of which year

about 70 were in use. At the close of 1898, 6,860 were set, with a consumption of 85,800,000 cubic feet. The averages of 1898 are: Gas per meter, 12,500 cubic feet; money per meter, £2, 6s., 10d.; price per 1,000 cubic feet, 3s. 9d. (90 cents)

The regular price of gas in Tottenham is 3s., and the 9d., or about 18 cents per 1,000, is an extra charge for meter rental and hire of the house piping, fittings, etc., supplied the tenant. At the end of 1899, the number of automatic meters in use was 8,000, which exceeded the number of ordinary consumers.

It has been found also that as those of the prepayment class increase in prosperity, request is often made to change over to the regular system. This is interesting from the fact that there has been some hesitation as to the use of prepayment meters through fear that all consumers would demand them. The average well-to-do consumer prefers to pay his bills when rendered at the end of a given period.

Discussion.

The President—The Secretary has a letter bearing on this subject which he will read to you.

The Secretary read the following letter:

"WOODBURY, N. J., March 15, 1900.

"Gentlemen: In answer to your inquiry about our experience with prepayment meters, will say: In June, 1897, a salesman came to Woodbury to do some business with our Company. In conversation with him I learned that they had perfected and were ready to take orders for prepayment meters. The idea was new to me, and struck me very forcibly, as at that time we were having more or less trouble with several consumers. I ordered two 5 light prepayment meters, and set one for our most dissatisfied consumer, and one for the Secretary of our Company; one in friendly hands and one in doubtful hands, in this way hoping to get a real test of the merits of the prepayment meter. It was a success from the start. We had a little trouble with the mechanical part of the first meters, but after being once changed by the Company we had no further trouble. Being particularly anxious to get a good prepayment meter, we watched the working of these meters with a great deal of interest. Our decision was favorable, so much so that we continued ordering them, until now, with a total of 700 meters set, 215 are prepayment meters. The prepayment meter has been a help to us in many ways. It is prompt paying and enables us to keep all consumers. We have added several consumers that would not have used gas except with one of these meters. All of our consumers using prepayment meters are pleased with them. In many cases we have had to change an ordinary meter to a prepayment meter to satisfy consumer. I am satisfied that they have increased our consumption of gas enough to more than offset the extra expense of the meters, besides keeping many consumers satisfied. Our people do not have any trouble in using meters after they are once explained. We have not had any meters robbed or in any way interfered with.

"After nearly three years' experience with prepayment meters, I have not anything but good to say for them. It is a clean, satisfactory way to do business on a cash basis. The money is always there, and consumers are satisfied because the gas bill is paid in a way that they do not feel it. We expect to continue purchasing prepayments, and I believe they will grow more popular every year. Very truly yours,

"CONSUMERS GAS CO., GEO. W. CURTIS, Supt."

The President—The Columbus Gas Company has had about 500 of them in use, I think, and Mr. Ritter can tell us the experience of the Company in their use.

Mr. C. S. Ritter—I do not wish to draw any conclusions regarding the relative merits or demerits of the prepayment meter system and the ordinary meter system. Some objections to prepayment meters that we have encountered it might be well to speak of at this time. In the first place I do not believe the factor of saving in loss from bad debts referred to exists, because I think that is entirely offset in losses occasioned by stealing from the meters and by the imperfect mechanism of the meters themselves. With 550 meters in use about a year and a half, we found an aggregate loss of about $100 a year by reason of imperfect mechanism and from theft. Another point I would like to speak of refers to the idea that placing a prepayment meter is apt to get a new customer; but how are we to distinguish between what would be really new and old consumers after we have all of the meters in use which we intend to use? Wouldn't it be necessary to solicit all the time, so far as prepayment meters are concerned, in order to determine whether we are getting new consumers by reason of their use? As far as our experience is concerned—I suppose in other localities it would be different—I believe that the bills are over-estimated. Our average at any time has not exceeded $1 per month for the meter per year; and the number of consumers who request to have the regular meter displaced by the prepayment meter I think entirely offsets the number of prepayment meters that you could place in use for consumers who would not otherwise become consumers. Our experience has been that those people who would not take gas except for the use of the prepayment meter are very poor customers. They do not use much gas. Frequently you have to put the meter in for two or three months before it is determined whether they are going to use gas at all or not, and then maybe have to finally take them out.

The President—Mr. Gribbel, have you anything to say upon this subject?

Mr. Gribbel—I can only concur in the remarks set forth by Mr. McIlhenny in his very interesting paper. I may say that the proof of the pudding is in the eating, and I think the gas men have found where the pudding is. Meter men can testify that the prepayment meter has proven such an unqualified success that they have had their hands full in satisfying their customers.

Mr. Ritter—I do not wish to be misunderstood or to be understood as saying that the prepayment meter is not a success. I do not say that at all. I think in different localities and under different circumstances it would be very much better than it has proven to be for us. I do not say it has not been a success but I only mention a few difficulties that we have encountered, some of which I think may in the future be remedied, and I have no doubt they can be to a great extent.

The President—I will call on Mr. Printz to give us his experience.

Mr. Printz—As we have but one prepayment meter in use I do not know that I can furnish any information for the members.

Mr. McIlhenny—A statement was made that in Columbus prepayment meters have not met the anticipations of the Gas Company, and I wish to say that probably the reason for it can be easily found. In the first place it will not do to expect a prepayment meter to accomplish too great results. That is, results which no meter can accomplish. In a city where natural gas is abundant and where it is used for illuminating purposes, I should say the prepayment meter would not be so well adapted as in other places where these conditions do not exist. The bulk of the people with whom prepayment meters can be used to advantage are essentially the poorer people—people who will not pay a bill at the end of the month or people who use gas in limited quantities, and would not use it at all were it not for the prepayment meter. Now the exclusively light business with such people amounts to very little. It is doubtful if with any of them it would pay at all. In many instances the bill would not amount to an average of over 25 cents per month. A bill for a small house where one room only is usually occupied and one gas jet going for a few hours in the evening amounts to very little; but if families are in locations where they cannot get natural gas at cheap prices or where illuminating gas is sold at a figure which they can use for fuel purposes, of course the bills average very much higher, and it is with that class of people where the prepayment meters make such headway. Where the customers use more gas for fuel than for any other purpose, by means of the prepayment meter they can control their expenditure by paying for it at the time. Consequently, where the customer does not use gas for fuel purposes, we cannot expect any greater returns from the prepayment meter than we would from the regular meter, or not much more. We get a little better return because he will be a little more liberal, but we cannot expect very much greater returns than from the ordinary meter.

On motion of Mr. Hayward, a vote of thanks was passed to Mr. McIlhenny for his valuable and interesting paper.

The Secretary read a letter from Mr. A. W. Fields, Secretary of the Columbus Edison Electric Light Company and the Columbus Electric Company, Columbus, Ohio, inviting the members to visit the plants of the named Companies. The badge of the Association would be sufficient to admit the members to and through the works.

The invitation having been accepted with thanks, on motion of Mr. Printz, the meeting was declared adjourned to 9:30 A. M., of March 22d.

[To be Continued.]

Laying a 36-Inch Water Main Under the Harlem River, N. Y.

Engineering News says that the city of New York has recently completed the laying of a 36 inch water main across the Harlem river, between Fordham Heights landing and 209th street, Manhattan. It is intended to better supply with water that long strip of territory lying between the Hudson and the Harlem river, and the line is chiefly remarkable for the excessive weight of the jointed pipe used in crossing the river.

At the point crossed the Harlem river is 1,200 feet wide; and, to meet future demands from commerce in this improved waterway, it was necessary to dredge a trench across the river to a depth of 30 feet below

mean low water. As there is a strong tidal current in the Harlem, since its recent improvement by the government, this trench gave considerable trouble, and constant dredging was required to remove the silt brought into it by the action of the current.

The flexible joint pipe used was 36 inches inside diameter, and was made to lay in 12 feet lengths, with a bell and spigot joint at the two ends. The joint itself is a modification of the Ward flexible joint, as devised by Mr. Duane. The bell was 5 feet in outside diameter at the extreme end, and was there reinforced by shrinking upon it an iron band, 6 inches wide and 2¼ inches thick; the bell was about 30 inches long. The spigot end was provided with two cast bands, 5 inches wide and rounded to fit the spherical interior of the bell; the dovetailed space between these bands was 6 inches wide by ¾ inch deep, and into this space was poured the lead which completed the flexible joint. Each of these joints required 1,100 pounds of lead. Each pipe length as delivered was 13 feet 1 inch long, 36 inches interior diameter and 40 inches exterior diameter in the body of the pipe. The wrought iron band referred to weighed 663 pounds, and the cast iron pipe weighed 13,725 pounds, or 14,388 pounds for the pipe length complete.

The work of laying the 1,200 feet of jointed pipe was commenced in June, 1899, and completed on December 6, 1899, by the contractor for this portion of the work, Mr. E. R. Lowe, of No. 2 Coenties Slip, New York. The method adopted by Mr. Lowe for laying the flexible pipe was about as follows: A strong float, 97 feet long and 35 feet wide, was provided with a steam derrick for handling the pipe sections; blocking for holding about 5 pipe lengths at one time on the boat; a launching way at one end of the float, etc. After the pipe had left the Fordham bank of the river, strong steel cables were securely attached to the pipe itself, and by means of these cables the float was handled and the pipe was launched, section by section. Four precautionary anchors were used to guard against damage to the float from passing vessels. But as each joint was completed, the steel cables were cautiously slackened, and the weight of the pipe practically pushed the float towards the far shore as one pipe length after another slipped into the water. The cables were then again made fast, and another pipe length was lifted, put in place, and attached, by pouring its joint, to the four lengths still remaining on the float; a repetition of this process, as pipe after pipe was added, finally resulted in the successful completion of the line across the river. The work required extreme care and great experience and judgment in handling the cables; and Mr. Lowe himself lived upon the float, day and night, throughout the operation. As it was city work, the cost of the pipe and its laying could not be ascertained. It might be mentioned that as the laying progressed the cables referred to were shifted by divers, as the conditions demanded.

Gas Companies and Peripatetic Gas Testing.

[By Mr. Norton H. Humphrys, in *Journal of Gas Lighting.*]

Although the use of the portable photometer has been recognized from time to time in connection with the work carried on by the Metropolitan Gas Referees, and has met with some degree of support, I am not aware that a case has ever been distinctly stated on behalf of the instrument and the system identified with it, the principal feature of which is that no testing room, as generally understood, is required. Under the present arrangements, gas can only be officially tested in certain specified rooms fitted up for the purpose. But with the portable photometer, the specified testing place becomes a superfluity, as any locality within a yard of a pipe charged with gas supplied by the company whose product is to be examined may be utilized for that purpose. I say supplied by the "company" advisedly, because the benefits attainable by the use of the photometer on wheels do not appear to have attracted attention in districts where the gas works are the property of the municipality. Many gas engineers have been looking for some authoritative pronouncement, showing not only the deficiencies of the present system, as regards a fair presentment of the interests of the consumers, but also the advantages of the new one in assisting the gas examiner towards a fair and impartial discharge of his duty, which is simply that of holding the balances fairly as between buyer and seller. Neither of the parties concerned requires more or less than this. While they do not wish the scales to be tipped in their favor, they would equally resist a stroke in the other direction.

But a great deal more hangs on the present arrangements for examining the illuminating power of the gas supply, than a mere adjustment of quality as between one side of the counter and the other. It has been adopted as an integral factor in the bargain between the sellers of gas on the one hand and Parliament as representing the public on the other, which is known in well informed circles as a "Special Act" or "Provisional Order," but to the majority of the public under the incorrect and misleading title of a "monopoly." Important questions relating to price and dividend are dependent upon it. The *status quo* of the present system must be maintained, if justice is to be adhered to. Sixteen candle gas is not a mere nonentity or will-of-the-wisp, but a tangible article that can be accurately defined, not only by the test of the photometer, but by the aid of chemical analysis, and by the materials and processes concerned in its manufacture. I do not wish to do any injustice to the peripatetic system. But high authorities have repeatedly asserted that the object of introducing it is to score strongly at the expense of the gas companies, by forcing them to supply gas at least 20 per cent. above the standard, in order to guard against its irregularities; and I do not know that this impeachment has been contradicted. At present the nominal 16 candle gas is actually 17½ to 18 candles; but with the portable photometer on the war path, the company would not be safe at even 19 candles. The gas companies are, in effect, to be compelled to supply a more costly article, while all other conditions of the bargain remain as before. Even if we grant that the present arrangements are inefficient, and that the portable photometer is perfectly fair as between buyer and seller, it is still a fact that the introduction of a not necessarily more rigorous, but a more uncertain, method of testing would be an injury and an injustice to the gas companies, as amounting to a breach of the parliamentary bargain.

While it has never been proved that the present arrangements for examining the gas supply are unduly favorable to the seller, and therefore prejudicial to the interests of the buyer, it is by no means uncertain that the portable photometer has a strong leaning in the other direction. One might almost add that this is its most favorable feature, in the eyes of its supporters. Any competitive photometrist, armed with a portable photometer and strict instructions to prove a conviction against the gas company under pain of the gallows, could save his neck, even if the quality of the gas was not less than 10 per cent. over the standard. These remarks are justified, because one claim in favor of the new plan is that the results obtained by its means are always below the indications recorded in the official testing room. But this is capable of two interpretations. It may, as assumed, be so much the worse for the gas; but, with at least equal probability, it may be so much the worse for the wheelbarrow photometer. Such a conclusion is favored by the irregular and widely varying readings obtained, because gas manufacturers, whatever their other faults may be, find it necessary to maintain uniformity of quality. If they sent out 14 candle gas on Monday, 17-candle gas on Tuesday, and 15 candle gas on Wednesday, the manager and his staff would find that life was not worth living on Thursday. If the portable photometer could be depended upon to trot along at a regular distance—say, 10 per cent.—behind its stationary relative, it might be possible to make something of it. When Mr. Sugg improved the standard argand burner, the parliamentary standard was raised in proportion. It was stated to get 2 candles more out of the gas; and so the standard was lifted from 14 to 16 candles—not as a means of scoring at the expense of the gas companies or increasing their responsibilities, but simply to preserve the position unaltered, and secure a gas in all respects equal to that previously supplied. But it is impossible to base a fair and square bargain on the indications of an instrument that runs at anything between neck and neck and a 25 per cent. deficit; and an adjustment of this nature could not be applied to the portable photometer. If the "portable" standard was put at 14, as compared with the "stationary" 16 candles, there would still be the element of uncertainty, due to the fact that the peripatetic system is intrinsically unfair as against the seller, and contrary to the spirit of similar legal enactments.

The statutory enactments which govern the testing of gas are an example of the class commonly known as the Adulteration Acts, which are framed with the object of securing that the free and independent, but ignorant (in a technical sense), Briton shall get full value for his money, and that the goods supplied to him shall be equal in value to a known standard. Gas is compared with the standard sperm candle, bread is put into the balances against an avoirdupois pound weight, whisky is tested for percentage of alcohol, butter is examined for the presence of inferior animal fats, coffee for chicory, etc.—all for the purpose of securing to the purchaser, when he spends a shilling, a fair shilling's worth in exchange. They do this and no more. He pays his shilling, and gets twelve pence value, and cannot claim anything between twelve and fifteen pence. Obviously the whole of the gas, bread, butter, whisky, coffee, etc., supplied to the public cannot be examined, just as the whole contents of a steam cargo boat may be passed through a customs house. So the first step in drafting any

Adulteration Act is to arrange for obtaining some small samples as a representation of the whole; and elaborate precautions must be taken to secure a fair sample. The true intent and meaning of the Acts is that the sample should be taken in a manner that is just to both parties, the seller as well as the buyer.

As regards gas, the photometer must be connected by a short service to one of the principal main pipes, and the gas must be lighted at least 15 minutes before the test is taken—which, in effect, means that the service pipe, meter, governor, etc., must be flushed out, and the test conducted upon a sample of the gas that is piping-hot from the main itself, and therefore a fair sample of the bulk. The gas company are entitled to have a representative present at the test, which means that they have a right to see this important condition fairly carried out, and generally that their interests are not prejudiced—inadvertently or otherwise—by any action on the part of the operator. With a similar object, the samples of bread, whisky, or butter are taken in a manner calculated to secure fair play all around. They must be purchased over the counter or from the delivery van in the ordinary way of business; the seller must be informed at the time that the sample will be analyzed, and he can if he chooses retain a portion of the same; the selected portion must be examined with the least possible delay; and so on—all with the view of guarding against a tip of the scales either one way or the other.

So far gas companies, as well as other traders, have been satisfied as to the taking of the sample. But bakers, publicans, and grocers would all very strongly object if as, a so-called improvement on the obviously fair methods of performing this operation, the inspector was allowed a free hand, and could go to any customer, and take samples of bread, whisky, or butter, without regard to the period of time that had elapsed since they left the tradesman's establishment, or to the treatment accorded to the commodities subsequent to their delivery. The baker would point out, with good show of reason, that the bread might have been placed in a warm corner, or otherwise so treated that it had lost weight considerably; the publican would suggest that the whisky bottle might not have been properly corked, with the result that its strength had been reduced by evaporation; and the grocer would ask for proof that the butter had not been tampered with, or exposed to dust or moisture, after leaving his shop. Strong objection would also be raised if the inspector was accompanied by an analyst and a trundling laboratory, prepared to make essays and write out a report on the spot. It would be said that the operations incidental to analysis were of a delicate and elaborate character, and could not be properly conducted except in a suitably fitted room.

All these objections can, and should, be urged by the sellers of gas. the portable photometer system leaves the method of taking the sample entirely to the discretion, not only of the examiner, but also of the individual consumer, who may be hostile to the company, or for personal reasons may wish to score a point against them. There are those who seek to obtain or to retain the public favor and confidence by striking the attitude of a doughty champion on their behalf, and who are occasionally driven to the necessity of dressing up a bogey antagonist. Failing other things, the gas supply can be utilized for this purpose. One admirable feature of the present systems, both for the testing of meters and the illuminating power of gas, is that the item of personal discretion is reduced to a minimum. All that is necessary is to follow the prescribed regulations with accuracy and conscientiousness. Care has also been taken to reduce the necessary corrections for error to the lowest possible limits. It is admitted that the corrections for rate of consumption of gas and of candles, and for variations in temperature and in barometrical pressure, are purely arbitrary and empirical; and, therefore, where it is impracticable to reduce them to an insignificant quantity, they are curtailed in every possible way. As soon as the necessity for care in this direction was recognized and put into practice, the limits of error as between one operator and another—formerly so flagrant as to bring discredit on the whole system—were reduced within practical bounds; and the days when the gas company made the quality 20 candles, and the gas examiner brought it out as 14 candles, have long passed away. The portable photometer system not only returns to these conditions, but goes a long step farther back, and promises a last state of things that will be worse than the first. Its use must, among other matters, entail considerable corrections for temperature; and probably this has something to do with the variations in results above noted, as it may be employed in and out of doors.

But what would be the practical outcome of the adoption of the system? As soon as the novelty of the thing had passed away, the customers would get tired of giving the use of their living or business apartments for the purpose of a temporary testing place. Unless actuated by such motives as above indicated, they have very little interest in the question. So the gas examiner would find himself and his outfit practically put out on the streets, and called upon to take snapshots at the street lamps. Here he would encounter difficulties due to weather and to exigencies of traffic. As in the case of indoor tests, after the novelty had passed away, his paraphernalia would be regarded as a nuisance. He could not work under the gloom of a London fog, or while exposed to heavy rain, snow or wind. Gradually he would gravitate down to a few sheltered localities—such as the ends of blind alleys—where he could pursue his investigations undisturbed by rumbling vehicles or jostling passengers, and be partially at any rate protected from the severity of the weather.

Under such circumstances there is no guarantee whatever or provision for securing a fair sample by flushing out the service and other pipes between the bulk of the supply and the apparatus; nor would it always be possible to do so. There should be no misunderstanding on this point. Coal gas is not an unstable compound that commences to deteriorate as soon as it leaves the works. In earlier days, when the importance of slow and gradual condensation was not thoroughly understood, it is quite possible that it may have lost a candle or two while traveling a few miles. But, as produced under modern conditions of condensation and purification, it is a fairly hardy article, not affected by ordinary conditions of supply. The bulk of the consumers get as good value as those living close to the gas works; and the supply to the official testing rooms is a fair sample of the whole. Yet it is quite possible that certain portions, representing an insignificant percentage of the whole supply, are subjected to particularly unfavorable circumstances. There may be such a thing as a half mile length of 3 inch pipe, originally laid for the supply of a large consumer, but now only utilized for a few lamps. Railway companies often lay several hundred yards of pipe on their own premises, for the supply of distant signal boxes. These pipes may, at particular points, be more or less exposed to the weather. A sample of gas drawn from the extreme end may have entered at the other perhaps 24, perhaps 30, hours previously, during which time it has been subject to the operations of exosmose and endosmose, to variations of temperature, and to the solvent action of hydrocarbons previously accumulated on the interior surface of the pipe.

If no other method than the portable photometer was available, some of these disadvantages could be minimized by restrictions limiting the length of service between a sufficiently representative main in regular use—say, not less than 8 inches in diameter—and the testing apparatus, and for securing a proper flush-out of the whole before testing. Maximum and minimum limits for pressure and temperature could be set, on the lines of those adopted for the sperm candle. But at best, the portable system would introduce a state of things far less satisfactory than the earliest attempts at a photometer room; and gas companies cannot regard it in any other attitude than that of uncompromising opposition, as contrary to the spirit of the Adulteration Acts, and as leaving no possible security for safety against conviction.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

"H. M.," WRITING from East St. Louis, Ills., under date of March 28th, says: "Regretfully I have to report the death of Mr. John Eimer, who passed away at his home in Belleville, Ills., the afternoon of March 24th. Deceased was for many years President of the Belleville (Ills.) Gas Light and Coke Company, and was a Director in the Peoria (Ills.) Gas Light and Coke Company and in the Kansas City (Mo.) Gas Light and Coke Company. He was born in Charlottenbach, Germany, April 7th, 1834, and came to America in 1850, going direct to Belleville where he entered the service of his uncle, the late Simon Eimer, who operated a brewery in Belleville. The brewery shut down in 1872, and Mr. Eimer, who had prospered in a business way, thereafter devoted himself to his gas interests and to the management of the Belleville Savings Bank. He is survived by his widow and two sons."

A CORRESPONDENT incloses the following, from Vineland, N. J., under date of April first: "The Vineland gas works have gone into the control of the Vineland Light and Power Company, the owners of which are Messrs. John B. Reynolds, A. A. Sterling and John Flanagan, of Wilkes-Barre, Pa., and Messrs. McGeorge and Newcomb, of Vineland. It is likely that Mr. H. T. Gerould will be retained as Superintendent. The new management proposes to put the gross selling rate at $1.50 per 1,000 cubic feet, with 5 per cent. off for prompt payment, and intends to expend a considerable sum on plant betterment."

MR. A. A. LOWE, of Brooklyn, N. Y., is erecting at Horseshoe, N. Y., a very elaborate plant for the manufacture of maple sugar. The construction will be fireproof, the buildings to be entirely of steel covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron roof covering. The contract for the work has been awarded to the Bridge Company.

THE Spring Valley Gas and Electric Company, of Spring Valley, Rockland County, N. Y., has been incorporated by Messrs. George M. Dunlop, John D. Dunlop and H. L. Hunt. It is capitalized in $40,000. This place is a post village of Ramapo township, N. Y., and is on the New Jersey and New York Railroad at a point 31 miles from New

York city. The Piermont and Suffern branch of the Erie Railroad also passes through it. Its population cannot exceed 2,200.

THE Colorado Springs (Col.) *Telegraph* of recent date says: "The Colorado Springs Light and Power Company will in a short time expend $50,000 in extending and enlarging its plant." The generating capacity per 24 hours is to be increased to 700,000 cubic feet. Several miles of mains will be put down.

C. H. STRUBLE and associates have petitioned the Council of Girard, Ohio, for the right to construct and operate an artificial gas plant in that town. Girard is a post village of Trumbull county, Ohio, and is located on the Mahoning river at a point 5 miles northeast of Youngstown. It is reached by two lines of railroad. A fairly good grade of coal is mined nearby, and it holds several important factories. It has a population of about 4,500.

THE Consumers Gas Company, of Johnstown, Pa., has purchased from the Cambria and Westmoreland Natural Gas Company its Johnstown system.

THE Lynn (Mass.) Gas and Electric Company has subscribed $150 towards the fund that is being collected for defraying the expense attendant upon the celebration of Lynn's 50th anniversary as a city. In addition to the subscription the Company will furnish the electric lighting designed for the illumination of the City Hall during the anniversary free of cost.

COLUMBUS, Ohio, wants an official inspector of gas and gas meters, who it is claimed can be appointed under section 2,484 of the revised statutes.

A CORRESPONDENT forwards the following from Darby, Pa.: "The Philadelphia Suburban Gas Company was incorporated in February, 1899, to purchase the Darby Gas Company and extend the supply of gas to the various boroughs in Delaware County, lying between Cobb's Creek on the east and Ridley Creek on the west. During the season of 1899 gas mains were laid in Lansdowne, Darby, Yeadon, Fernwood, Sharon Hill, Colwyn and Collingdale, and nearly 1,000 consumers added. This work has kept a large number of men constantly on the Company's pay roll, at times amounting to over 200. The coming season the Company will extend its mains to Eddystone, supplying Glenolden, Norwood, Prospect Park, Ridley Park, Alan, Clifton, Rutledge, Swarthmore and Media. The gas plant to supply the entire territory is located on Darby Creek at Pine street, and is a model one, capable of supplying a city of 50,000 inhabitants, and is completed with the exception of a storage holder, which will be completed soon. The Darby office of the Company is truly a suburban office, and a neat one, where gas ranges and other gas appliances are displayed. A Lansdowne office will soon be established with a regular attendant. The officers of the Company are: President, W. Lane Verlenden; Secretary, F. H. Shelton; Superintendent, J. D. Shattuck. The policy of the Company has been most liberal. It is the first corporation that has ever offered a money consideration for a franchise in Delaware County. Its annual payment to the borough of Darby alone will pay the interest on $12,000 of the borough debt."

THE new office building for the Quincy (Ills.) Gas and Electric Company will be ready for occupancy by June 15th. Its location, on Main street between 4th and 5th streets, is an excellent one, being right in the business center of the city.

A CORRESPONDENT writes: "The demand by the Lake Forest (Ills.) City Council for $10,000 for a gas franchise there has caused the applicant, the Waukegan Gas Company, to withdraw its petition. The franchise was desired not only for service in Lake Forest, but to connect the works at Waukegan with North Chicago, Fort Sheridan, Highwood and Highland Park. A new plant may be built at Highland Park to furnish that city, Ravinia, Highwood and Fort Sheridan. The Company has secured the Government's consent to pipe the reservation, and the action of the Lake Forest Council will not hinder its going ahead with the work as originally planned, except that the southern cities will be lighted from a plant to be built there."

MR. WALTER D. FIELD, who, in 1898, succeeded the late Mr. A. T. Schuessler as inspector of gas and gas meters for Newark, N. J., died in Newark the morning of March 30th. He was in his 35th year.

MR. W. H. PEARSON, General Manager of the Consumers Gas Company, of Toronto, Can., has notified the Fire and Light Committee of Toronto City Councils, referring to the matter of lighting the summer resort known as the Island, that provided the Company receives a favorable answer to a request which it has made to the Canadian Pacific Railway for permission to lay a pipe along the Queen's wharf to its southeasterly limit, it will lay a pipe across the western channel, and will supply gas to the Island residents on the following conditions: The net price of gas for all purposes to be $1.50 per 1,000 cubic feet. The Company will not undertake to supply gas before May 1 or after October 15 in any year. The Company will not hold itself reponsible for any interruption in the supply of gas owing to a leakage or accident to the pipes, or from any other cause beyond the Company's control.

MR. FRANCIS B. WHITTEMORE, cashier and chief accountant for the Consumers Gas Company, of Toronto, Canada (he had been in its service since 1863), died suddenly the afternoon of March 29th. He was in his 54th year.

FROM the report of Mr. Charles D. Jenkins, Inspector of Gas Meters and Illuminating Gas for the State of Massachusetts, we learn that during the year 1899 gas meters to the number of 30,445 were inspected. Of these 29,960 were new meters. Using here the exact words of the report: "The remaining meters, 485 in number, belong to the class of 'complaints.' By the provisions of Section 12, Chapter 61, Public Statutes, 'Meters in use shall be tested by the inspector or by his assistant or deputy on the request of the consumer or of the gas light company.' Meters so tested are called 'complaints,' and the results of such tests follow. One meter would neither pass gas nor register; 11 would pass gas but would not register. The average error of the *remaining* 473 meters was 0.64 per cent fast; the law allows a meter to be stamped as correct that does not vary more than 2 per cent. either way from the standard measure; 199 meters, 41.04 per cent. of the total number reinspected, were fast, the average error being 4.64 per cent.; 49 meters, 10 10 per cent, were slow, the average error being 13.52 per cent; 225 meters were correct within the legal limits. Of the fast meters, 118 were between 2 and 5 per cent., 73 between 5 and 10 per cent, 7 between 10 and 15 per cent., and 1 between 15 and 20 per cent. Of the slow meters, 19 were between 2 and 5 per cent., 17 between 5 and 10 per cent., 5 between 10 and 15 per cent., and 1 between 15 and 20 per cent.; and there was 1 each 20, 25, 30, 35, 60, 105 and 160 per cent. slow." The two last named percentages are just as the Inspector returned them.

THE Inspector calls attention to the necessity of, and the good returns which would accompany, closer watch over gas "burners, burners for lighting and heating * * * A burner recently tested gave, on proper regulation, a candle power of 23.1 when burning 5 feet of gas; by simply opening the cock and supplying more gas, a candle power of only 21.2 was developed, although 10 2 cubic feet of gas were being consumed. By using burners of this sort the amount of gas consumed would be more than twice as much as in the first case, and the light actually obtained more than 8 per cent. less."

THE Legislature of Maryland has passed a bill declaring that "No corporation or person shall charge for illuminating gas in Baltimore city a sum to exceed $1.10 per 1,000 cubic feet. The measure will become effective on June 1st next, in that the Constitution of the State specifies that no law passed shall take effect until that date unless the act expressly declares to the contrary.

THE City Council of Rockford, Ills., has refused to grant an extension of the Carbon Dioxide Company's franchise—reported to be a Chicago concern—the scheme of whose projectors was to do a whole lot of things in the refrigerating and fire extinguishing line, and then to dispose of illuminating gas, made in "the line," as a by-product, at $1 per 1,000. The original franchise was granted some years ago, but nothing was ever done under it.

THE 53d annual meeting of the Montreal (Can.) Gas Company, which was held the last week in March, was quite a satisfactory one, in that the reports showed an increasing trade and smooth relations with the authorities and the consumers. During the year 2,573 meters were placed; also, 1846 gas ranges, heaters, etc. The reports made special mention of the loss sustained by the Company in the death of Mr. Hugh McLennan, who had served it for 23 years as a Director and for 17 years as President. The total receipts for the year were $763,760.62, of which $634,817 came from gas sales. The net revenue amounted to $373,147.55, and the dividends declared called for the disbursement of $299,964. The Companys plant and properties were in good shape, and ample for any demand made upon them.

The Market for Gas Securities.

The showing for the week in local gas shares was a hardening in values, save in the instance of New Amsterdams, which went off about 2 points from the highest. Consolidated sold up to 193 to-day (Friday), and the close was 191 to 192. Standard common was another strong feature. The adjournment of the Legislature, the knowledge that nothing harmful to the gas interests was done by it, and the further well grounded belief that selling prices are to be restored to the legal rate tend to encourage purchases both for speculative and investment account.

Brooklyn Union is showing its value, and it will show it more in the near future. Peoples, of Chicago, advanced sharply on fairly well authenticated statements that an understanding with the Ogden Company's controllers had been reached. Consolidated, of Baltimore, is in some demand. The compromise gas rate bill to $1.10 per 1,000, passed by the Legislature seems satisfactory all round. The stock should go to 75. There is not much doing in Lacledes. Cincinnati gas is steadily rising to the 200 mark.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 Wall Street, New York City.

April 9.

☞ All communications will receive particular attention

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$54,595,200	100	191	192
Central Union, Bonds, 5's.	3,000,000	1,000	103½	105
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	115	118
Metropolitan Bonds	658,000	.	108	112
Mutual	3,500,000	100	275	300
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	
New Amsterdam Gas Co.	13,000,000	100	29	30
Preferred	10,000,000	100	..	34
Bonds, 5's	11,000,000	1,000	99¾	100½
Northern Union, Bonds, 5's.	1,250,000	1,000	95	97
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	109	111
" 1st Con. 5's	1,500,000	..	115	..
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	110	115
Preferred	5,000,000	100	125	140
Bonds, 1st Mortgage, 5's	1,500,000	1,000	110	114
Yonkers	299,65	500	130	.
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	153½	154
" " Bonds (5's)	15 000,000	1,000	118	119
Bay State	50,000,000	50	1⅝	1¾
" Income Bonds	2,000.000	1,000	..	75
Binghamton Gas Works,.	450,000	100	40	..
" 1st Mtg. 5's	475,000	1,000	96½	99½
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	..	77½
2d " " "	3,000,000	1,000	42	45
Buffalo City Gas Co.	5,500,000	100	5	8
" " Bonds, 5's	5,250,000	1,000	69	71
Central, San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,207,000	1,000		108
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	60	65
Preferred	3,026,500	100	84	86
Consumers, Jersey City Bonds	600,000	1,000	102	105
Cincinnati G. & C. Co.	8,500,000	100	195¾	196½
Consumers, Toronto	1,700,000	50	240	235
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	11,000,000	100	55½	55¾
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	19	21
" Con. Mtg. 5's	380,000	1,000	87	90
Consolidated G. & E. Co.'s., Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,560,000	50	95¾	96
" Prior Lien 5's	4,598,000	1,000	99½	100
Detroit Gas Co., 5's	386,000	1,000	100	101
" Inc. 5's	16,000	100	100½	101
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	35	41
" Bonds	2,000,000	..	60	64
Grand Rapids Gas Lt. Co..	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	..
Hartford	750,000	25	..	220
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	102	105
Indianapolis	2,000,000	..	100	105
" Bonds, 6's	2 650,000	..	101	103
Jackson Gas Co	250,000	50	72	78
" 1st Mtg. 5's	250,000	1,000	101	102½
Lafayette Gas Co., Ind	1,000,000	100	40	45
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	106	
Laclede, St. Louis	7,500,000	100	73	75
Preferred	2,500,000	100	96	96½
Bonds	10,000,000	1,000	110	110½
Madison Gas & Elec. Co.	400,000	100	82	..
" 1st Mtg. 6's	350,000	1,000	102½	108
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Con. Gas Co	6,000,000	..	..	..
Bonds, 6's	4,600,000	..	..	..
Essex and Hudson Gas Co.	6,500,000	..	35	40
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	43	45
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	110½	110¾
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	111⅜	111½x
2d "	2,500,000	1,000	104	105
Rochester Gas & Elec. Co..	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90

Advertisers' Index.

GAS ENGINEERS.

	Page
Wm. Henry White, New York City	599
Fred. Bredel, Milwaukee, Wis.	586
Geo. R. Rowland, New York City	597
The Western Gas Construction Co., Fort Wayne, Ind.	604
Humphreys & Glasgow, New York City	597
American Gas Co., Phila., Pa.	586
David Leavitt Hough, New York City	596
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	583
Baxter & Young, Detroit, Mich.	596
United Gas Improvement Co., Phila., Pa	591
James T. Lynn, Detroit, Mich	596
A. E. Boardman, Brevard, N. C	596

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd's Sons, New York City	600
Continental Iron Works, Brooklyn, N. Y.	598
Deily & Fowler, Phila., Pa.	600
Kerr Murray Mfg. Co., Fort Wayne, Ind	596
Stacey Mfg. Co., Cincinnati, Ohio	599
Bartlett, Hayward & Co., Baltimore, Md.	597
Davis and Farnum Mfg. Co., Waltham, Mass.	596
R. D. Wood & Co., Phila., Pa.	598
Isbell-Porter Company, New York City	598
Fred. Bredel, Milwaukee, Wis.	586
United Gas Improvement Co., Phila., Pa.	591
National Gas and Water Co., Chicago, Ill.	593
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	583
The Western Gas Construction Co., Fort Wayne, Ind.	604
Humphreys & Glasgow, New York City	597
American Gas Co., Phila., Pa.	586
Logan Iron Works, Brooklyn, N. Y.	600
Riter-Conley Mfg. Co., Pittsburgh, Pa.	599
Baxter & Young, Detroit, Mich.	596
Berlin Iron Bridge Co., East Berlin, Conn.	585
G. Shepard Page's Sons, New York City	596
James T. Lynn, Detroit, Mich.	596
A. E. Boardman, Brevard, N. C.	596
Sutherland Construction & Improvement Co., N.Y. City	584
Chris. Cunningham & Son, Brooklyn, N.Y.	582

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md.	597
United Gas Improvement Co., Phila., Pa.	591
Burdett Loomis, Hartford, Conn.	598
National Gas and Water Co., Chicago, Ills.	593
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	583
The Western Gas Construction Co., Fort Wayne, Ind.	604
Humphreys & Glasgow, New York City	597
Sutherland Construction & Improvement Co., N.Y. City	584
B. E. Chollar, St. Louis, Mo.	584

SCRUBBERS AND CONDENSERS.

R. D. Wood & Co., Phila., Pa.	598
James R. Floyd's Sons, New York City	600
Continental Iron Works, Brooklyn, N. Y.	598
Logan Iron Works, Brooklyn, N. Y.	600
Riter-Conley Mfg. Co., Pittsburgh, Pa.	599

TAR AND CARBONIC ACID EXTRACTOR.

R. D. Wood & Co., Phila., Pa.	598

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich.	580
American Gas Company, Phila., Pa.	586

GAS METERS.

John J. Griffin & Co., Phila., Pa.	560
American Meter Co., New York and Philadelphia	603
Helme & McIlhenny, Phila., Pa.	603
D. McDonald & Co., Albany, N.Y.	601
Nathaniel Tufts Meter Co., Boston, Mass.	602
Maryland Meter and Mfg. Co., Baltimore, Md.	602
Metric Metal Co., Erie, Pa	603
Keystone Meter Co., Royersford, Pa.	602
Detroit Meter Company, Detroit, Mich.	603

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia	603
John J. Griffin & Co., Phila., Pa.	560
D. McDonald & Co., Albany, N.Y.	601
Helme & McIlhenny, Phila., Pa.	603
Nathaniel Tufts Meter Co., Boston, Mass.	602

GAS AND WATER PIPES.

M. J. Drummond & Co., New York City	601
R. D. Wood & Co., Phila., Pa.	598
Warren Foundry and Machine Co., New York City	601
Donaldson Iron Co., Emaus, Pa.	601
Chris. Cunningham & Son, Brooklyn, N.Y.	582
Cornell & Underhill, New York City	580

PIPE CUTTERS.

The Anderson Pipe Cutter Co., East Boston, Mass.	581

GAS MAIN STOPPERS.

Safety Gas Main Stopper Co., N. Y. City	583

GAS TAPPING MACHINES.

George Light, Dayton, O.	580

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, Brooklyn, N. Y.	593

GAS COALS.

Penn Gas Coal Co., Phila., Pa.	595
Perkins & Co., New York City	594
Despard Gas Coal Co., Baltimore, Md.	595
Westmoreland Coal Co., Phila., Pa.	595
Berwind-White Coal Mining Co., New York and Phila.	594

CANNEL COALS.

Perkins & Co., New York City	594

CONVEYORS.

The Link-Belt Machinery Co., Chicago, Ills.	583

GAS ENRICHERS.

Standard Oil Co., New York City	595
The Sun Oil Co., Pittsburgh, Pa.	595

COKE CRUSHER.

C. M. Keller, Columbus, Ind.	595

GAS GAUGES.

The Bristol Co., Waterbury, Conn.	585

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City	593
Isbell-Porter Co., New York City	598
R. D. Wood & Co., Phila., Pa.	598
Wm M. Crane Co., New York City	582

CEMENTS.

C. L. Gerould, Galesburg, Ills	592

RETORTS AND FIREBRICKS.

J. H. Gautier & Co., Jersey City, N. J.	592
Adam Weber, New York City	592
Laclede Firebrick Mfg. Co., St. Louis, Mo.	592
Cyrus Borgner, Phila., Pa.	592
James Gardner, Jr., Pittsburgh, Pa.	592
Henry Maurer & Son, New York City	592
Baltimore Retort and Firebrick Co., Baltimore, Md.	592
Parker-Russell Mining and Mfg. Co., St. Louis, Mo.	592
Brooklyn Firebrick Works, Brooklyn, N. Y.	592

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md.	597
Fred. Bredel, Milwaukee, Wis.	586
J. H. Gautier & Co., Jersey City, N. J.	592
Parker-Russell Mining and Mfg. Co., St. Louis, Mo.	592
Adam Weber, New York City	592

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Co., New York City	598
Continental Iron Works, Brooklyn, N.Y.	598
Logan Iron Works, Brooklyn, N. Y.	600
R. D. Wood & Co., Phila., Pa.	598

INCANDESCENT GAS LAMPS.

Welsbach Commercial Co., Phila., Pa.	590

BURNERS.

C. A. Gefrorer, Phila., Pa.	598
Wm. M. Crane Co., New York City	583
D. M. Steward Mfg. Co., Chattanooga, Tenn.	583

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn.	583

STREET LAMPS.

Welsbach Street Lighting Co., New York and Phila..... 588
Thos. T. W. Miner, New York City..... 580

PURIFIERS.

Stacey Mfg. Co., Cincinnati, O..... 584

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City 593

VALVES.

Ludlow Valve Manufacturing Co., Troy, N. Y. 585
Chapman Valve Manufacturing Co., Boston, Mass..... 585
R. D. Wood & Co., Phila., Pa..... 598
Continental Iron Works, Brooklyn, N. Y..... 598
The P. H. & F. M. Roots Co., Connersville, Ind..... 587
Isbell-Porter Co., New York City..... 598
The Western Gas Construction Co., Fort Wayne Ind.... 604

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind..... 587
Isbell-Porter Company, New York City..... 598
Connelly Iron Sponge and Governor Co., New York City 593

ELECTRICAL APPARATUS.

Wm. Henry White, New York City 599

ENGINES AND BOILERS.

The Hazelton Boiler Company, New York City..... 580

PURIFIER SCREENS.

John Cabot, New York City..... 585

GAS STOVES.

American Meter Co., New York and Philadelphia..... 589
Maryland Meter and Manufacturing Co., Baltimore, Md. 602
Keystone Meter Co., Royersford, Pa..... 602
Wm. M. Crane Co., New York City..... 582
Nathaniel Tufts Meter Co., Boston Mass..... 602
National Stoves, Lorain, O..... 581
Abendroth Brothers, Port Chester, N. Y..... 581
Detroit Stove Works, Detroit, Mich..... 587
Dangler Stove and Mfg. Co., Cleveland, O..... 581

HOT WATER HEATERS.

Wm. M. Crane Co., New York City..... 582

GASHOLDER TANKS.

J P. Whittier, Brooklyn, N. Y..... 597

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md..... 597
Continental Iron Works, Brooklyn, N. Y..... 598
Deily & Fowler, Philadelphia, Pa..... 600
Davis & Farnum Mfg. Co., Waltham, Mass..... 596
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 596
Stacey Mfg. Co., Cincinnati, Ohio..... 599
R. D. Wood & Co., Philadelphia, Pa..... 598
Logan Iron Works, Brooklyn, N. Y..... 600
Riter-Conley Mfg. Co., Pittsburgh, Pa..... 599
Chris. Cunningham & Son, Brooklyn, N.Y..... 582

GAS SECURITIES.

Henry Marquand & Co., New York City..... 580

ADVERTISING.

J. Howland Harding, New York City..... 580

DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO.,
N. W. CORNER BROAD AND ARCH STS.,
PHILA., PA., Mar. 14, 1900.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable April 14, 1900, to stockholders of record at the close of business March 31. Checks will be mailed.

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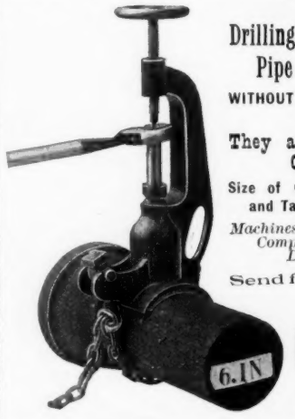

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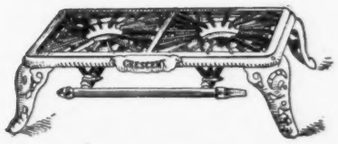

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Ottawa,	250,000	Caterham, Eng.	150,000
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Lindsay (Remodeled),	125,000	Leicester, Eng.	2,000,000
Belleville,	250,000	Buenos Ayres (River Platte Co.),	700,000
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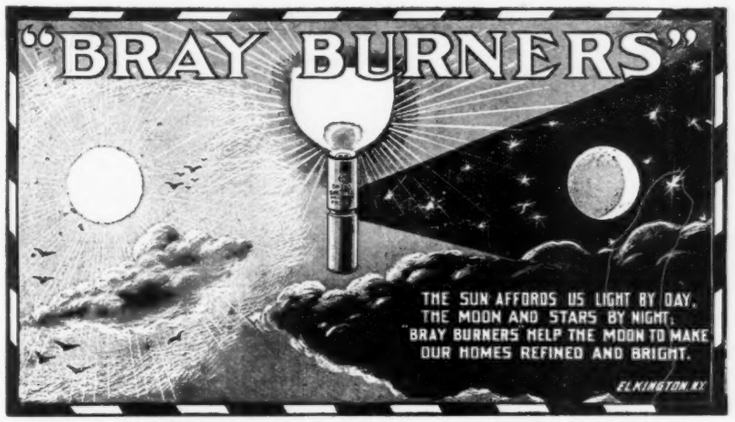
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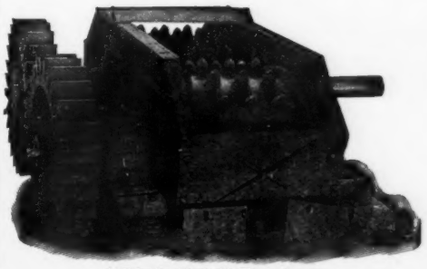

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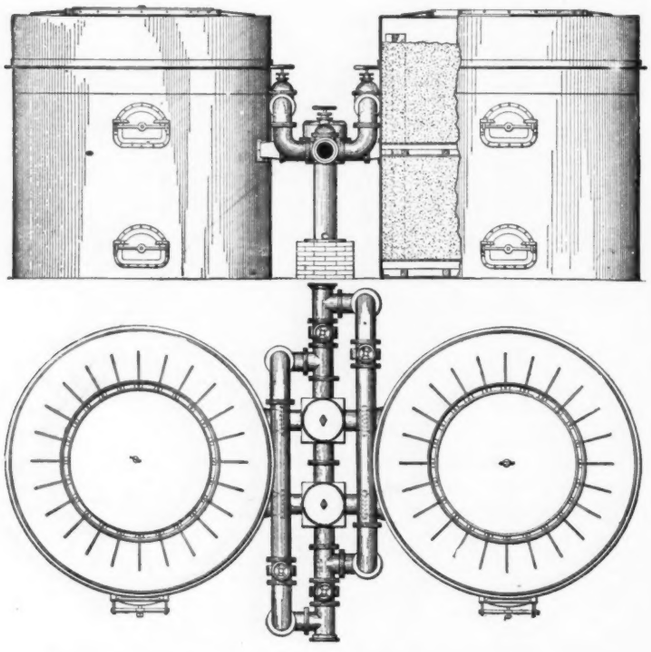

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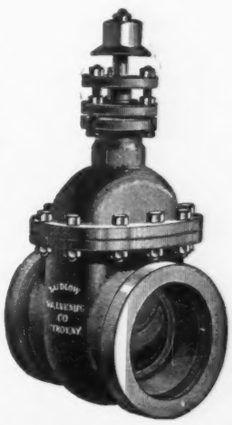

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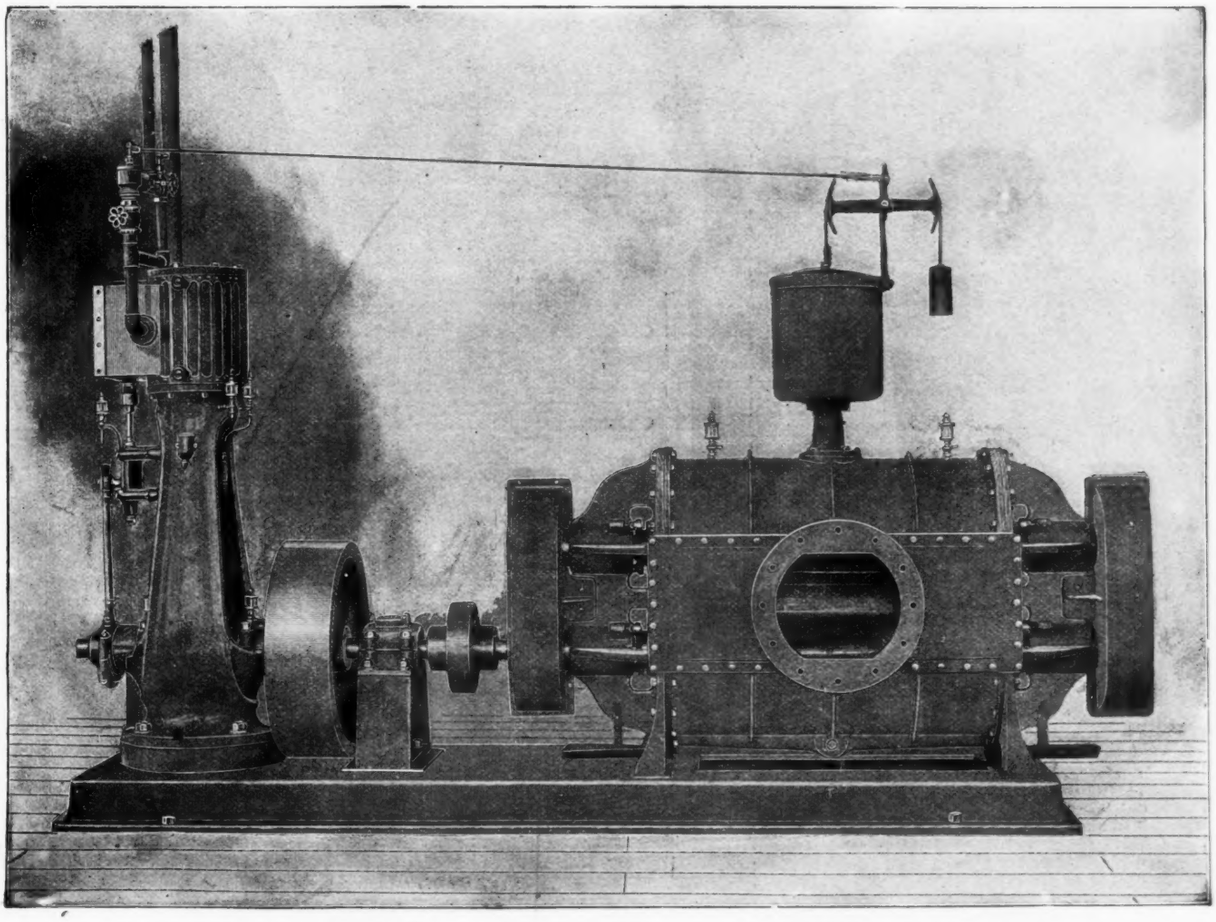

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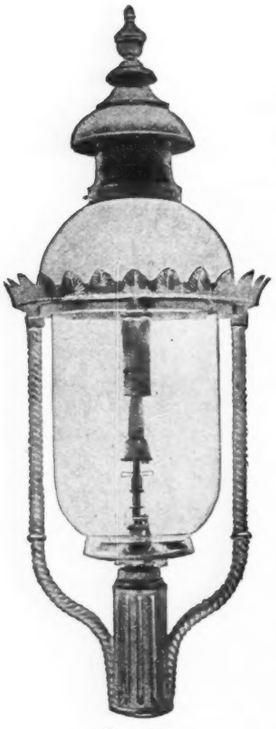

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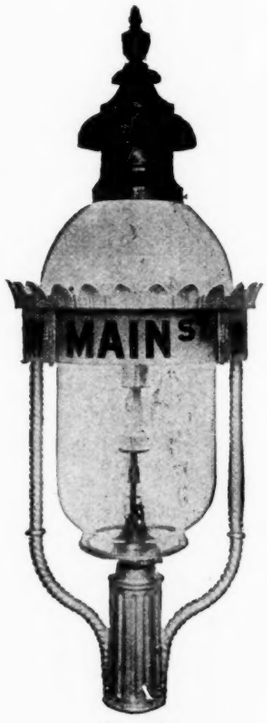

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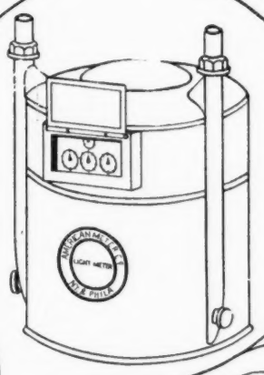
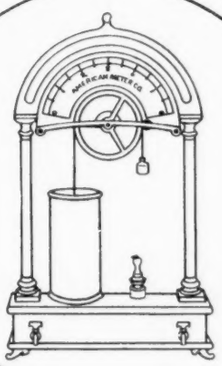
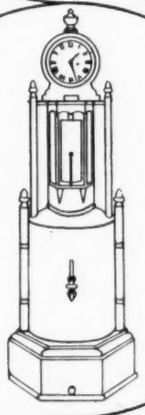
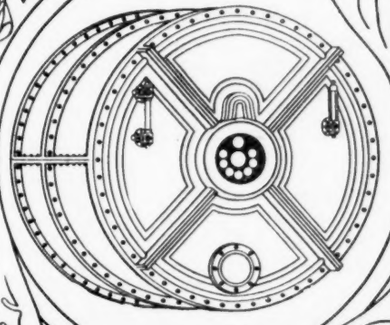








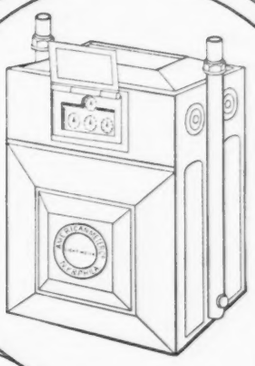
PUBLIC LIGHTING TABLE.

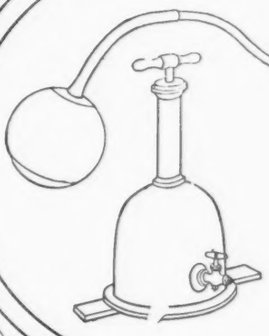
APRIL, 1900.

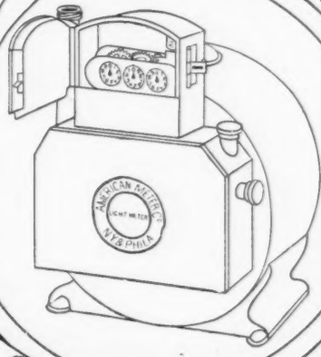
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Sun.	1	7.00 PM	4.40 AM	6.10	4.55
Mon.	2	7.00	4.40	6.15	4.40
Tue.	3	7.00	4.40	6.15	4.40
Wed.	4	11.10	4.40	6.15	4.40
Thu.	5	12.00	4.40	6.15	4.40
Fri.	6	12.40 AM FQ	4.40	6.15	4.40
Sat.	7	1.10	4.40	6.15	4.40
Sun.	8	1.40	4.30	6.15	4.40
Mon.	9	2.10	4.30	6.25	4.30
Tue.	10	2.30	4.30	6.25	4.30
Wed.	11	3.00	4.30	6.25	4.30
Thu.	12	3.20	4.30	6.25	4.30
Fri.	13	No L.	No L.	6.25	4.30
Sat.	14	No L. FM	No L.	6.25	4.30
Sun.	15	No L.	No L.	6.25	4.30
Mon.	16	7.10 PM	9.40 PM	6.30	4.20
Tue.	17	7.10	10.30	6.30	4.20
Wed.	18	7.10	11.30	6.30	4.20
Thu.	19	7.10	12.20 AM	6.30	4.20
Fri.	20	7.10	1.10	6.30	4.20
Sat.	21	7.10	1.50	6.30	4.20
Sun.	22	7.20 LQ	2.30	6.30	4.20
Mon.	23	7.20	3.10	6.40	4.10
Tue.	24	7.20	3.40	6.40	4.10
Wed.	25	7.20	4.10	6.40	4.10
Thu.	26	7.20	4.10	6.40	4.10
Fri.	27	7.20	4.10	6.40	4.10
Sat.	28	7.20 NM	4.10	6.40	4.10
Sun.	29	7.20	4.00	6.40	4.10
Mon.	30	7.20	4.00	6.45	4.00

TOTAL HOURS LIGHTING DURING 1900.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	230.50	January	423.20
February	175.40	February	355.25
March	189.00	March	355.35
April	160.30	April	298.50
May	150.40	May	264.50
June	137.00	June	234.25
July	152.00	July	243.45
August	171.50	August	280.25
September	187.20	September	321.15
October	213.10	October	374.30
November	221.50	November	401.40
December	231.50	December	433.45
Total, yr.	2221.40	Total, yr.	3987.45







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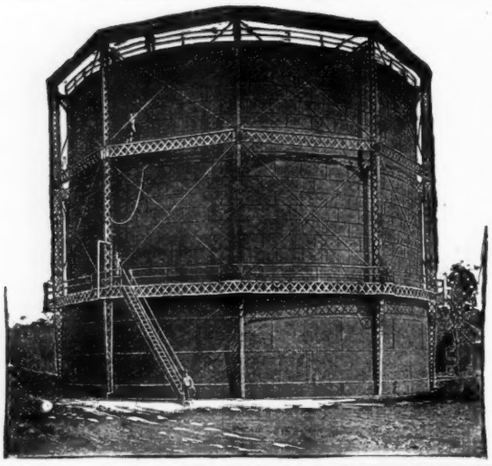

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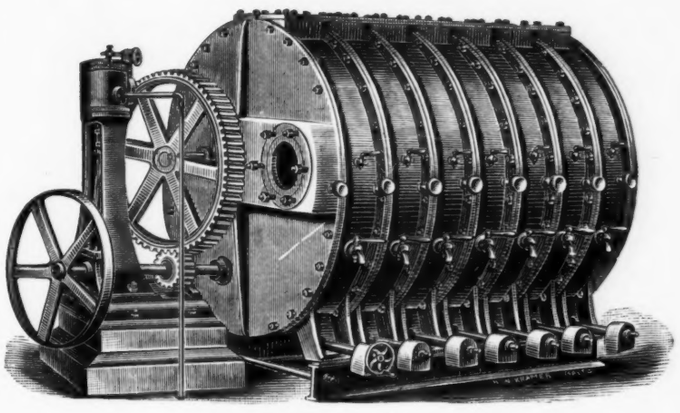

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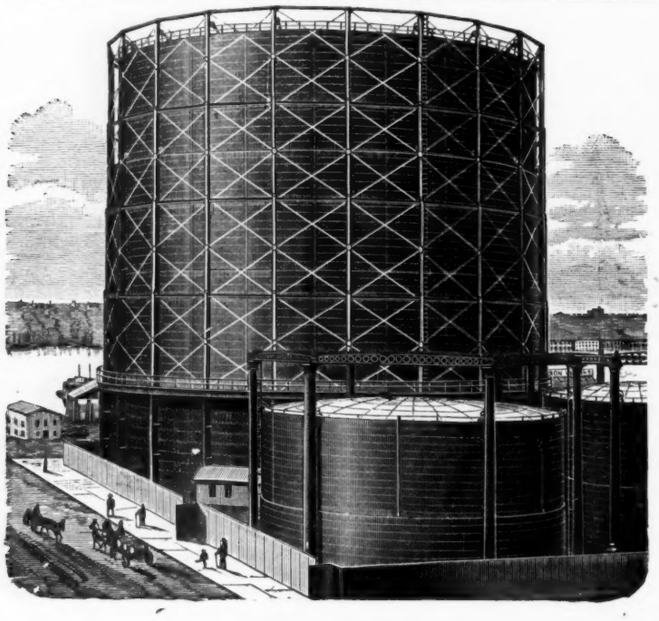

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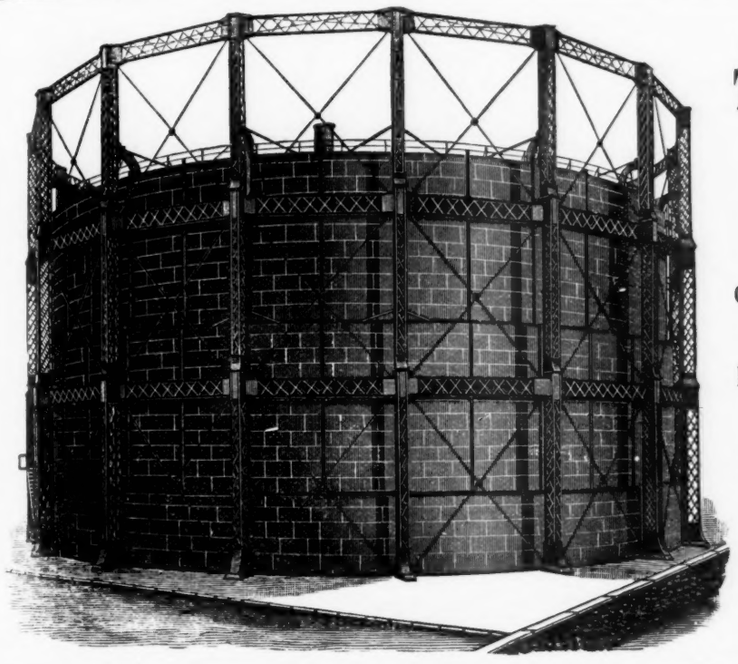

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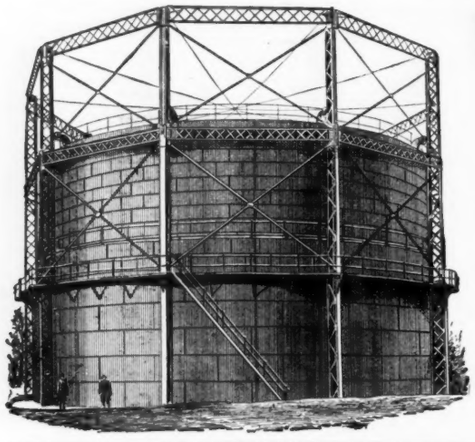

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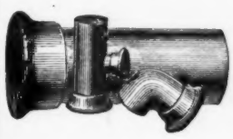

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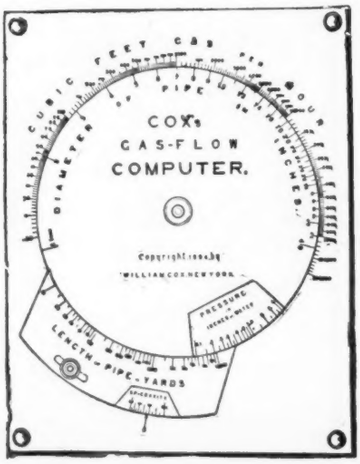

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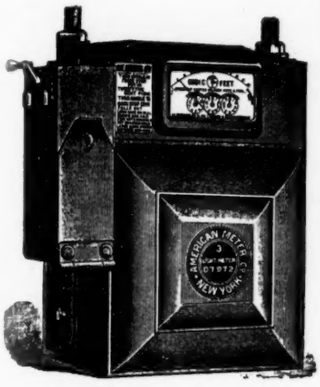

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